NOTA LEPIDOPTEROLOGICA

Published by Societas Europaea Lepidopterologica (SEL)

Volume 32 · Number 1 · 2009

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA e.V.

http://www.soceurlep.eu

HONORARY MEMBERS

Günter Ebert (D), Pamela Gilbert (GB), Barry Goater (GB), Peter Hättenschwiler (CH), Prof. Dr Niels P. Kristensen (DK), Dr Yuri P. Nekrutenko (UA)

COUNCIL

President:	Dr Gerhard Tarmann (A)
Vice-President:	Prof. Dr Joaquin Baixeras (E)
General Secretary:	Dr David Agassiz (UK)
Treasurer:	Dr Robert Trusch (D)
Membership Secretary:	Willy De Prins (B)
Ordinary Council Members:	David Demerges (F), Prof. Dr Konstantin A. Efetov (UA), Dr Jörg Gelbrecht (D), Dr András Kun (H), Dr Nils Ryrholm (S)
Editors:	Dr Niklas Wahlberg (FIN) Dr Bernard Landry (CH), Dr Matthias Nuss (D)

ISSN 0342-7536

Type setting: blattwerk|dd

Printed by Druckhaus Dresden GmbH

NOTA LEPIDOPTEROLOGICA

A journal focussed on Palaearctic and General Lepidopterology
Published by the Societas Europaea Lepidopterologica e.V.

http://www.soceurlep.eu

Volume 32 No. 1 · Dresden, 15.5.2009 · ISSN 0342-7536

Contents

The authorship of the so-called 'Wiener Verzeichnis'

Klaus Sattler [1] & W. Gerald Tremewan [2]

[1] Department of Entomology, Natural History Museum, Cromwell Road, London SW7 5BD, U.K.;
email: k.sattler@nhm.ac.uk
[2] Pentreath, 6 Carlyon Road, Playing Place, Truro, Cornwall TR3 6EU, U.K.;
email: wgt.pentreath@btinternet.com

Abstract. The authorship of the so-called 'Wiener Verzeichnis', published anonymously in Vienna in 1775/1776, is discussed. In the interest of stability, it is contended that the work should be attributed to [Denis & Schiffermüller], as cited by the International Commission on Zoological Nomenclature in Opinion 516 (1958). Moreover, evidence is provided showing that contemporaries of Ignaz Schiffermüller and Michael Denis also considered the work to have been written by 'die Theresianer', i.e. multiple authors, and not by Schiffermüller alone, as considered by some current authors.

Introduction

The authorship of the anonymously published, so-called 'Wiener Verzeichnis' has almost always been attributed to Michael Denis and Ignaz Schiffermüller. Moreover, the work was even attributed to these authors by the International Commission on Zoological Nomenclature in Opinion 516 (Hemming 1958). However, in a recent paper, Kudrna & Belicek (2005) present what they consider to be 'totally convincing' evidence that Schiffermüller alone was the author. As we shall demonstrate, there are many flaws in their arguments and, as a consequence, we consider their conclusions to be incorrect.

The 'Wiener Verzeichnis'

The famous 'Wiener Verzeichnis' of 1775/1776 was the most influential work on early European lepidopterology towards the end of the 18th century and has repeatedly been the subject of papers concerning its correct title, year of issue, authorship and availability of names. It was first published in 1775 under the title *Ankündung eines systematischen Werkes von den Schmetterlingen der Wienergegend* and, a year later, as *Systematisches Verzeichniß der Schmetterlinge der Wienergegend*. Although the different titles suggest different editions the text was printed only once (Prout 1900: 158); however, there are two different frontispieces (Kudrna & Belicek 2005: figs 4, 5), two different title pages (Kudrna & Belicek 2005: figs 2, 7) and two different, mirror-reversed versions of the plates (both versions coloured and uncoloured). These were subsequently combined in several different ways, but as entomologists only ever had two or three copies available for comparison they believed that there existed different, clearly definable editions of the work (Sattler 1970; Wolff 1972).

Kudrna & Belicek call attention to a remarkable copy of the 'Wiener Verzeichnis' in the present library of the Theresianum in Vienna. That copy is unique in that it has both title pages (1775, 1776), the two known frontispieces, two mirror-reversed monochrome plates and two mirror-reversed colour plates. A closer study would be worthwhile to establish whether it could have been Schiffermüller's working copy, as Kudrna & Belicek consider possible. It should be noted that in the library of the Forschungsinstitut und Naturmuseum Senckenberg in Frankfurt there exists another interesting copy that initially belonged to J. C. Gerning (who is mentioned in the Nachtrag of the 'Wiener Verzeichnis' as the collector of several species from Frankfurt) and was later acquired by C. von Heyden. This copy is also accompanied by both title pages and additionally has a unique printed index of 29 pages with independent pagination (pp. 1–29), which lists, in double column, all the species in the 'Verzeichnis'. Although obviously intended to be alphabetical, the index is curiously jumbled with some individual names and even entire sections appearing out of sequence in unexpected places. The index is clearly of the same time as the 'Wiener Verzeichnis' but differs in the vignette at the top of each page. Promitzer (1990: 433) mentioned such an index as published in 1776; however, we do not know whether that information is based on the Frankfurt copy or whether there exists a second copy elsewhere.

The original water-colour illustrations may not have been executed by Schiffermüller himself (as Kudrna & Belicek, p. 4 imply) but were perhaps the work of Landerer (who was responsible for the two different frontispieces) and possibly other artists, as implied on p. 237 ('... um uns und *unsere* ... *Künstler* [plural] zu üben ...'). There is also a reference in Schröter (1776: Vorrede) according to which the illustrations will be made '... unter der Aufsicht [under the supervision] des Herrn Professor Schiefermüller ...'. In our opinion, Kudrna & Belicek (2005: 5) make too much of a distinction between editorship and authorship that was not as clear in the 18th century as it is today. Interpreting the words '*herausgegeben von ...*', meaning *issued by* ... [literally: *given out*], in modern terms as editor, editor-in-chief or scientific editor, is stretching it too far. We agree with them that these words do not clearly indicate two authors – nor, however, do they preclude the existence of two authors – but they certainly indicate that there was more than one author involved.

The fact that a copy in the Senckenberg library in Frankfurt has both title pages even led to speculation that only the *Systematisches Verzeichnis* existed, and that the title page *Ankündung* had originally been merely part of a brief prospectus that was later added to the *Verzeichnis* by a librarian (Sattler 1970: 2). A similar copy with both title pages is present in the library of the Theresianum in Vienna (see above). But several copies having solely the *Ankündung* title are also known (Kudrna & Belicek, 2005: 4) and it is evident that the book was originally distributed under that title.

There is no doubt that the *Ankündung* was to announce a detailed work on the Viennese Lepidoptera to be entitled *Die Schmetterlinge der Wienergegend untersuchet, und systematisch beschrieben*. The authors say so quite clearly in their introduction (pp. 5–9, I. Abschnitt. Entwurf des Werkes) where they discuss at length the layout of the work to come; they also give two sample plates (pls Ia, Ib) with detailed accompanying text (pp. 244–304) on the illustrated species. Schiffermüller had secretly begun to collect insects in 1757 (Promitzer 1990: 429; Speta 2003: 12), but when this became more widely known amongst his colleagues, he received such enthusiastic encouragement that he collaborated with others (especially his friend Denis) in about 1764 with the intention of producing a comprehensive, well-illustrated work on the Lepidoptera of the Vienna district. By good fortune someone in their midst had artistic talent (and experience in architectural drawings) and undertook to draw the larvae from live specimens because their colours could not be preserved. Seven years later, on 16 March 1771, the foreword ('An den Leser') was dated, presumably on completion of the manuscript for the *Ankündung* (pp. 1–304); as a result of long delays in press, a supplement ('Nachtrag', pp. 305–322) was added, followed by an unnumbered page with a few corrections of misprints and errors, before the book was finally published in 1775. By that time it had become clear that changed circumstances no longer permitted the completion of such an ambitious project (Denis, 1780), and that may have been the reason for changing the title from *Ankündung* [announcement] to *Systematisches Verzeichniß* [systematic check list].

With regard to the title *Ankündung* (rather than *Ankündigung*) it was quite unnecessary for Kudrna & Belicek (2005: 3) to pour scorn on Hemming for having meticulously marked the appearance of the word *Ankündung* with '[sic]' wherever it occurred in Opinion 516. Moreover, it is also immaterial whether the noun *Ankündung* was correct in the 18th century – Kudrna & Belicek erroneously refer to the 17th century – it is sufficiently unusual that the insertion of '[sic]' behind it, whilst perhaps a little pedantic, was by no means unjustified. After all, the Viennese authors themselves used the more usual standard German *Ankündigung* in the body of their text (p. 8) and so did their contemporaries such as the anonymous reviewer in the *Jenaische Zeitungen* (Anonymous 1775) and Schröter (1776) amongst others.

On this subject Hemming (1958: 20) stated reasonably enough:

'*Note on the title of the above work*: The first word of the title of this work is commonly cited in the literature as being "Ankündigung", though sometimes it appears in the shorter form "Ankündung". ... Inspection of the copy of this work in the Linnean Society of London shows however that the spelling used in its title is the archaic shortened form "Ankündung" and not the longer form "Ankündigung" which would be employed today.'

Before accusing Hemming of being 'obviously unfamiliar with the German language ...', Kudrna & Belicek should have read Opinion 516 carefully and having done so ensured the accuracy of German words used in their own paper (e.g. 'geistlicher Vater' when 'geistiger Vater' was meant). Had Hemming not had a thorough knowledge of German, it would hardly have been possible for him to have done so much research on the 'Wiener Verzeichnis', or on the works of Hübner, Herrich-Schäffer, etc., which culminated in his two-volume magnum opus *Hübner* published in 1937.

The date of publication

In accordance with the provisions of the *International Code of Zoological Nomenclature*, the International Commission on Zoological Nomenclature (Hemming 1958) established the *Ankündung* as 'published on an unspecified date after 17th May 1775 and before 8th December 1775', the latter being the date when the work was first reviewed in *Jenaische Zeitungen von Gelehrten Sachen* (not '*gelehrnten*' as Kudrna & Belicek write). This was the best evidence at the time and Kudrna & Belicek's contention that 'this decision is wrong' is itself disputable, because the date of Schiffermüller's letter to Linnaeus (11 September 1775) is still within that range. Had that letter materially affected the decision in Opinion 516, the Commission would have been informed of that fact at the time of its discovery (Sattler 1970).

The authorship

Who exactly is entitled to authorship or co-authorship of a scientific publication? Surely not just the person who finally puts pen to paper or, nowadays, finger to keyboard. In the present authors' view the authorship of a scientific work should primarily reflect the scientific responsibility for anything that is published! In determining the authorship of the 'Wiener Verzeichnis' we consider as paramount the wishes of the people involved, in particular those of Schiffermüller as the leading author. Schiffermüller's autobiography, which is preserved in manuscript form, leaves no doubt that he had only agreed to this enterprise after Denis promised his help. Collaboration between him and Denis grew extremely close, in fact, so much so that never was anything written up unless both of them were satisfied of its accuracy (Promitzer 1990: 432).

We also attach some weight to the views of contemporary authors who, almost without exception, considered the 'Wiener Verzeichnis' as the work of more than one author and, more specifically, as that of Schiffermüller & Denis or vice versa. With regard to the sequence of authors' names it should be noted that in the distant past senior/junior or first/second author has never played the role that it does nowadays in Anglo-Saxon countries; in fact, authors were frequently listed in alphabetical sequence and there were fewer, if any, squabbles over who should be cited first.

From the very beginning the contemporaries of Michael Denis and Ignaz Schiffermüller used almost exclusively the **plural** when talking of the authorship, as hardly any of them had any doubt about a multiple authorship of the 'Wiener Verzeichnis'. But the collection was usually, though not exclusively, considered as belonging to Schiffermüller; it went with him to Linz, where it was consulted by, amongst others, Schrank (in 1783), Fabricius (in 1784) and Hübner (in 1797), before Schiffermüller took it with him into his retirement in Waizenkirchen from where it was taken to Vienna after his death, only to be destroyed by fire in 1848. All that survives today are some duplicates that were given to Fabricius on the occasion of his visit to Linz (Karsholt & Gielis 1995: 32). Ironically, had attempts at that time succeeded in securing the collection for the British Museum (Speta 2003: 13) it would still be in existence!

There follows a sample of contemporary views on the authorship of the 'Wiener Verzeichnis'.

Anonymous (1775) refers to '[die]Herren Professoren Schiffermüller und Denis'.

Schröter (1776: Vorrede, pp. [i]–[xx], [xiv]–[xvii]) refers to 'Hr Professor Schiefermüller, und Herr Professor Denis'.

Esper (1776–[1830]: **1**: 98, 190, 211; **2**: 224) refers to 'Die Herren Verfasser [plural for 'Author'] des Verzeichnisses der Wiener Schmetterlinge ...'.

Denis (1780) refers to 'Schiffermüller und Denis'.

Schrank (1785), who visited Schiffermüller in Linz and consulted his collection, refers to 'Herr Rath Schiffermüller' and his system only, without mentioning Denis.

Illiger (1801: vii) refers to 'Denis & Schiffermüller' and 'Das System der Wiener [plural] (unter dem Namen ist es allgemein bekannt.)'. When this new edition of the 'Wiener Verzeichnis' was published, Denis (1729–1800) had only just died whilst Schiffermüller (1727–1806) lived for another five years.

Ochsenheimer (1807: 12) refers to '... die Verfasser [plural] des Verzeichnisses der Schmetterlinge der Wiener Gegend ...'.

Fabricius (1819: 107) refers to '... die Verfasser [plural] des Verzeichnisses der Schmetterlinge der Wiener Gegend ...'. He mentions that he had met Denis (and other entomologists) in Vienna before proceeding to Linz specifically to see Schiffermüller and his collection, referring to him as 'Der eigentliche Verfasser [the principle author] des Wiener Verzeichnisses, Schiefermüller ...'. We are aware that 'Der eigentliche Verfasser ...' might leave some room for interpretation but in the light of the simultaneous reference to 'die Verfasser' [plural] a few lines earlier we cannot translate it other than as principle or leading or main author.

Charpentier (1821: vii) refers to '... Sammlung Schiffermillers [sic]...' and '... von Schiffermillers Hand geschriebenen Bestimmungen...'. Otherwise he refers quite consistently throughout the book to '... die Theresianer ... (der Theresianer, den Theresianern)' (plural, e.g. pp. 39, 56, 81, 101, 150).

Zincken, genannt Sommer, *in* Charpentier (1821: Vorrede, p. xii) refers to '... Sammlung der Verfasser ...' (plural).

Percheron (1837) lists the 'Wiener Verzeichnis' first under Denis ('conjointement avec Schiffer-Muller [sic]') (**1**: 82) and later under 'Schiffer (Muller)' ('conjoiniement [sic] avec Denis') (**2**: 39), in both instances referring to the *Verzeichnis* (although under slightly different titles) but citing it as published in 1775. Both entries are full of spelling errors.

Hübner (1816–[1825]) uses extreme abbreviations ('Schiff. Verz.') in the *Verzeichniss bekannter Schmettlinge*, but reference to other Hübner works shows that it was not meant to signify single authorship by Schiffermüller as Kudrna & Belicek (2005: 6) suggest. Hübner's other works demonstrate that he was well aware of the multiple authorship. For example, in the *Systematisch-alphabetisches Verzeichniss* (1822: v) he specifically introduced the abbreviation 'S' for 'Schiffermüller und Denis'; there is also ample reference to multiple authors ('... die Herren Theresianer...' [plural]) or even specifically to 'Schiffermüller und Denis' in the *Sammlung europäischer Schmetterlinge*.

Hübner made many references to the Wiener Verzeichniss in volumes 1 and 8 of his *Sammlung europäischer Schmetterlinge* (1796–[1836]), as follows:

1: [i]: 'Die von ... den Herren Theresianern, Schiffermüller und Denis ... den Schmetterlingen ertheilten Namen ... '.

1: 3, footnote 3: 'Diese Benennung [Schmetterlinge] führten schon die ehemaligen Herren Theresianer [plural!], durch ihr systematisches Verzeichniß der Schmetterlinge der Wienergegend ein, ... '. The very first species mentioned in that volume is referred to as *Papilio Cynthia* der Theresianer [plural!], whilst in following species the authors are abbreviated to 'd. Ther.'.

1: 124: 'Die Herren Theresianer, Schiffermüller und Denis …'. In addition there is ample reference to 'die Herren Theresianer …' [plural] throughout the text (e.g. pp. 6, 43, 45, 47, 61).

8: [3]: '... die Lehrer [plural] am … Theresianum …'.

In their eagerness to prove Schiffermüllers's sole authorship, Kudrna & Belicek have missed a rare but decisive document in which Denis himself lists his name as that of co-author. In a catalogue, published in 1780, of the 'Merkwürdigkeiten' [curiosities] in the Garelli library, of which Denis was at that time the librarian, he recorded, for the year 1776, 'Systematisches Verzeichniß der Schmetterlinge der Wienergegend, herausgegeben von einigen Lehrern am k.k. Ther. Verlegts Bernardi. gr. 4. von Schiffermüller **und Denis** [the present writers' emphasis].' Denis goes on to say that the continuation of that work had been interrupted for some years, as a result of Schiffermüller having been promoted to the directorship of the Nordisches Collegium in Linz (Denis 1780). Kudrna & Belicek (2005: 6) considered it as 'wholly inconceivable' that Schiffermüller, as a devout [not devote] Jesuit, would have denied Denis, his closest friend and brother Jesuit, the co-authorship if the latter had deserved such recognition, but one could argue with similar force that neither would Denis have usurped undeserved co-authorship.
As further evidence against Denis being a co-author, Kudrna & Belicek referred to the fact that Denis had left the Theresianum in 1773, two years before the publication of the *Ankündung*. However, they overlooked the fact that the foreword ('An den Leser'), presumably written on completion of the manuscript, is dated 16 March 1771 and thus well before Denis had left his post. Moreover, in the *Nachtrag* (p. 305) reference is made to considerable delay during the printing process.
Whilst Schiffermüller might name a *Tinea denisella* (p. 138) in honour of his co-author, we consider it rather unlikely that this modest man, were he the sole author, would simultaneously name a *Tinea schiffermillerella* (p. 142) after himself! We assume that the latter name was proposed by one of his collaborators, probably Denis.
Kudrna & Belicek (2005: 6) considered it noteworthy that Forster & Wohlfahrt (1952–1955) and Higgins & Riley (1970) had attributed authorship of the butterflies to Schiffermüller alone. However, Forster & Wohlfahrt were not specifically concerned with authorships[1]; they used extreme abbreviations for all authors, and the usage of 'Schiff.' does not signify anything with regard to single or multiple authorship. Whilst it is true that Higgins & Riley attributed the names only to Schiffermüller in their first edition, and this is followed in several foreign editions, they switched to 'Denis and Schiffermüller' in their later editions (e.g. edn 4, 1980).

---

[1] Nor, for that matter, were they much concerned with the then current nomenclature/taxonomy, as witnessed in volume 3 of their work in which they raised to full genera, without explanation, various nominal subgenera in the genus *Zygaena* Fabricius!

Summary

Whilst we acknowledge that Kudrna & Belicek have produced an interesting and beautifully illustrated historical paper on the 'Wiener Verzeichnis', they have presented no convincing evidence that Schiffermüller was the sole author of the work. In contrast, it is shown in the present paper that, notwithstanding Schiffermüller's leadership and monumental personal contribution, he did not see himself as the sole author, whilst his contemporaries also considered the book to be the work of more than one person and credited Denis with co-authorship. In the interest of stability, if not for historical accuracy alone, we suggest that the long-established (50 years) current practice of attributing the work (and all new names established therein) to Denis & Schiffermüller, as cited in Opinion 516, is adhered to.

We should point out that we do not wish to comment specifically on Kudrna & Belicek's proposals with regard to the availability of certain butterfly names. But whilst each name has to be considered on its own merit, we call attention to the fact that the majority, if not all, of Denis & Schiffermüller's names can be accepted as available (Sattler & Tremewan 1984). We urge lepidopterists to interpret the provisions of the *Code* as far as possible in favour of preserving the old established names and thereby contributing to stability. Moreover, we fail to understand where Kudrna & Belicek (p. 2) got the idea that Koçak (1982, 1984, 1986) and Sattler (1970 – not 1969!) rejected the *Ankündung* for the purposes of zoological nomenclature – in fact, the exact opposite is the case. Koçak explicitly separated those names he considered available from those that he considered to be nomina nuda, whilst Sattler clearly indicated how to cite the species described in the *Ankündung*.

References

Anonymous 1775. Rezension. – Jenaische Zeitungen von Gelehrten Sachen LXXXXVIII. Stück. Pp. 825–826.

Charpentier, T. von 1821. Die Zinsler, Wickler, Schaben und Geistchen des systematischen Verzeichnisses der Schmetterlinge der Wiener Gegend. Mit Anmerkungen von J. L. T. F. Zincken genannt Sommer. – Schulbuchhandlung, Braunschweig. 178 pp.

Denis, M. 1780. Die Merkwürdigkeiten der k.k. garellischen öffentl. Bibliothek am Theresiano. – Augustin Bernardi, Wien. 770 pp. [Not seen except copy of title page and part of page with entry on *Systematisches Verzeichniß*.]

[Denis, M. & I. Schiffermüller] 1775. Ankündung eines systematischen Werkes von den Schmetterlingen der Wienergegend. – Augustin Bernardi, Wien. 323 pp., 3 pls.

[Denis, M. & I. Schiffermüller] 1776. Systematisches Verzeichniß der Schmetterlinge der Wienergegend. – Augustin Bernardi, Wien. 323 pp., 3 pls.

Esper, E. J. C. 1776–[1830]. Die Schmetterlinge in Abbildungen nach der Natur mit Beschreibungen. – Wolfgang Walthers, Erlangen. **1–5**.

Fabricius, J. C. 1819. Autobiographie des Naturforschers Fabricius. – Kieler Blätter für 1819 **1**: 88–117.

Forster, W. & T. A. Wohlfahrt 1952–1955. Die Schmetterlinge Mitteleuropas. – Frankh'sche Verlagshandlung, Stuttgart. **1–5**

Hemming, F. 1937. Hübner. – Royal Entomological Society, London. **1**: xxiv, 605 pp., frontispiece; **2**: ix, 274 pp.

Hemming, F. (Ed.) 1958. Opinion 516. Determination under the plenary powers of the relative precedence to be assigned to certain works on the order Lepidoptera (Class Insecta) published in 1775, by Pieter

Cramer, Michael Denis & Ignaz Schiffermüller, Johann Christian Fabricius, Johann Casper Fuessly, and S. A. von Rottemburg respectively. – Opinions and Declarations rendered by the International Commission on Zoological Nomenclature **19**: 1–43.

Higgins, L. G. & N. D. Riley 1970. Field guide to the butterflies of Britain and Europe (Edn 1). – Collins, London. 380 pp., 60 pls, text-figs, 371 distr. maps.

Higgins, L. G. & N. D. Riley 1980. Field guide to the butterflies of Britain and Europe (Edn 4). – Collins, London. 384 pp., 63 pls, text-figs, 384 distr. maps.

Hübner, J. 1796–[1836]. Sammlung europäischer Schmetterlinge. – [Privately published,] Augsburg. **8**: 78 pp. (1796), 71 pls (1796–[1836]). [For dates of publication, see Hemming, 1937: 291–302.]

Hübner, J. 1816–[1825]. Verzeichniss bekannter Schmettlinge. – [Privately published,] Augsburg. 431 pp. [For dates of publication, see Hemming, 1937: 517.]

Hübner, J. 1822. Systematisch-alphabetisches Verzeichniss aller bisher bey den Fürbildungen zur Sammlung europäischer Schmetterlinge angegebenen Gattungsbenennungen; mit Vormerkung auch augsburgischer Gattungen. – [Privately published,] Augsburg. vi, 81 pp.

[Illiger, J. C. W.] 1801. Systematisches Verzeichniss von den Schmetterlingen der Wiener Gegend. Herausgegeben von einigen Lehrern am kaiserl. königl. Theresianum in Wien. Mit einer Synonymie der vorzüglichsten Schriftsteller und vielen Anmerkungen und Zusätzen von neuem herausgegeben. – Schulbuchhandlung, Braunschweig. **1**, 482 pp. **2**, 284 pp.

Karsholt, O. & Gielis, C. 1995. The Pterophoridae described by J. C. Fabricius, with remarks on type material of Fabrician Lepidoptera (Insecta). – Steenstrupia **21**: 31–35.

Koçak, A. Ö. 1982, 1984. On the validity of the species group names proposed by Denis & Schiffermüller, 1775 in Ankündung (sic.) eines systematischen Werkes von den Schmetterlingen der Wiener Gegend. – Priamus **2**: 5–42 (1982); **3**: 98–130, 133–154 (1984).

Koçak, A. Ö. 1986. On the paper "The Lepidoptera names of Denis & Schiffermüller – a case for stability" by K. Sattler and W. G. Tremewan in 1984. – Priamus **4**: 3–12.

Kudrna, O. & J. Belicek 2005. On the 'Wiener Verzeichnis', its authorship and the butterflies named therein. – Oedippus **23**: 1–32, figs 1–7.

Ochsenheimer, F. 1807. Die Schmetterlinge von Europa. – Gerhard Fleischer jun., Leipzig. **1**: 240, xxx pp.

Percheron, A. 1837. Bibliographie entomologique. – Paris. **1**: xii, 326 pp.; **2**: 376 pp.

Promitzer, C. 1990. Ignaz Schiffermüller – eine Fallstudie zur österreichischen Naturgeschichte im Zeitalter der Aufklärung. – *In*: H. Ebner, H. Haselsteiner & I. Wiesflecker-Friedhuber (eds), Geschichtsforschung in Graz. Festschrift zum 125-Jahr-Jubiläum des Instituts für Geschichte der Karl-Franzens-Universität Graz: 427–441.

Prout, L. B. 1900. On the 'Ankündung eines systematischen Werkes von den Schmetterlingen der Wienergegend' of Schiffermüller and Denis. – Annals and Magazine of Natural History (7) **6**: 158–160.

Sattler, K. 1970. Das „Wiener Verzeichnis" von 1775. – Zeitschrift der Wiener Entomologischen Gesellschaft **80**: 2–7, pls 1–3.

Sattler, K. & W. G. Tremewan 1984. The Lepidoptera names by Denis & Schiffermüller – a case for stability. – Nota lepidopterologica **7**: 282–285.

Schrank, F. von P. [1784]. Entomologische Nachrichten. – Neues Magazin für die Liebhaber der Entomologie **2**: 199–222.

Schröter, J. S. 1776. Abhandlungen über verschiedene Gegenstände der Naturgeschichte. – Gebauer, Halle. 488 pp.

Speta, F. 2003. Ignaz Schiffermüller (1727–1806) – eine Biographie. – Denisia **8**: 11–14.

Wolff, N. L. 1972. Schiffermüller og "Systematisches Verzeichniss" (Lep.). – Entomologiske Meddelelser **40**: 177–184.

Zincken, J. L. T. F. 1821. – See Charpentier, T. von, 1821.

Lafranchis, T. 2004. Butterflies of Europe. New Field Guide and Key. – DIATHEO, Paris. 351 pp., 13 × 19 cm, softcover. ISBN 2-9521620-0-X. Price: 32,00 € (+ 3,20 € postage).

This book is an impressive, pocket field guide supported by more than 1300 colour figures of living butterflies and skippers, which are reproduced from photographs by B. Watts, T. Benton and D. Jutzeler. It is a richly illustrated identification key accompanied by distribution maps; line drawings are also provided when identifications require special attention to detail and selected characters. The book has been very well received and reviewed and it has been accepted by the lepidopterist community as a valuable addition to the existing literature.

However, it is being reviewed again in *Nota lepidopterologica* because of the necessity to discuss and rectify some of the remarks by Tristan Lafranchis in the introduction of his work. The main intention of his guide is to make it possible to identify butterflies and skippers in the field without collecting and killing them. For this he has undertaken remarkable effort and, without doubt, has succeeded in creating an excellent book based on his views that lepidopterists should be prevented from collecting specimens. Lafranchis formulates his ideas as 'a wish'. He writes, '... Very recently, I found people overcollecting local butterflies in Greece and in southern France, killing dozens of specimens of the same species at the same place in a couple of hours. Asking them why, they always answered it was for some study, but this argument did not stand up to questioning. They were really killing butterflies only for their collections, for exchange or for trade. Even some serious lepidopterists still consider they have to collect most of the European butterflies to identify them carefully at home. I hope this book will help to convince everybody that almost all the butterflies flying in Europe can be identified in the field and alive. Collecting should be reserved for small insects of difficult orders, excluding both butterflies and dragonflies. Killing and trading should be banned in the whole of European Union, as it is in the case in Spain and Germany, scientists only getting a permit when they really need to collect specimens for study. We now need more studies on the ecology and the biology of butterflies, in order to understand them and to prevent their decline. We hope that the few nets we will see in the future will be carried only to check some difficult butterfly before releasing it. These creatures are really much nicer seen in a flowery slope than put in a line in a cabinet drawer'.

As the acting head of the Conservation Committee of SEL and the current SEL President, I cannot avoid commenting on such words even though I appreciate some of the views of Lafranchis. I accept his wish to contribute to nature conservation and I agree with him that mass collecting of selected, well-known species merely for the sake of dealing has nothing to do with science. However, his well-intentioned words reflect many dangers. For example, they could influence authorities to compensate their often helpless attempts to protect nature from the omnipresent destruction of biotopes through agriculture and forestry, industry and building lobbies, by drawing even further attention to entomologists and 'identifying' them as an easy target to blame for the decline of species biodiversity and population densities in Europe. The consequences of this could be disastrous. The existing restrictions on fieldwork would increase, it would become more difficult to transport specimens and even laws that forbid private reference collections can well be imagined.

If we want to conserve nature and Lepidoptera especially, we need a European-wide programme to emphasise, especially to young people, that the diversity of nature is a real treasure. In order to succeed we have to teach people how to learn as much as possible about species and their life histories. Children between the age of 8 and 13 years old can easily be inspired by the wonders of biodiversity. Because of their enquiring minds, they will want to know the names of various species and to recognise differences. For this some collecting is absolutely essential, as one has to be trained to recognise different characters. To look carefully and to observe the habits of larvae and adults also requires training and sometimes one has to be inspired to find a love for such exacting work. Accurate documentation of observations has to be learned, as well as the proper preparation of specimens and the accuracy of their labelling; in this respect, a small reference collection has always been the best method of reaching such a goal.

Lafranchis is correct when he states that many of the European butterflies can be identified in the field and that it is therefore not necessary to collect and kill them. This can be accepted if the aim of fieldwork is, for example, monitoring populations and counting population densities of well-known, easily recognisable species, or observing the habits of such species – in this respect I have to agree that a lot of valuable work can be done without killing specimens. However, not a single species of Lepidoptera would ever have been recognised as new and therefore not have been described (including all the butterflies and skippers) if it were based on observations alone. In order to acquire genuine documentation of sustainable value we need to have collected specimens for reference purposes. The study of microscopic external and internal morphological characters, Mendelian genetics and modern DNA analyses, and the comparison of geographical differences between populations, cannot be undertaken without possessing collected material. Moreover, it is dangerous to use butterflies as an example against collecting, as they are almost a synonym for all Lepidoptera in the minds of the average laypersons. Who but an entomologist or zoologist knows that butterflies represent only a very small percentage of the order? Banning the collection of butterflies could inevitably lead to a total ban on the collecting of Lepidoptera. The majority of Lepidoptera species cannot be accurately identified in the field by observation alone, or by looking at photographs of them, even when the observer is an experienced local person who knows the fauna of a restricted area very well. What is needed are many knowledgeable recorders and the way to become a good recorder is through responsible collecting and accurate documentation.

We all know that, because of the dramatic decline of their biotopes to their small, present-day relict areas, most of the populations of butterfly species that are threatened have decreased from what were formerly rich populations with wider distributions. Collecting has hardly ever been a real factor for such population decline although, of course, there have been a few exceptions in those localities where the populations were already small and extremely isolated. In such exceptional cases a complete ban on collecting a certain species would then be justified. I realise that a positive aspect in motivating young people to observe nature and to collect a few insects can, in very few cases, easily turn a person that is greedy by nature into the well-known 'maniac collector'. I hope Tristan Lafranchis was thinking of this when he states, '… they were really killing butterflies only for their collections, for exchange or for trade'. We all know that such people do exist, but fortunately they are few and far between. Therefore, it should be emphasised that serious and responsible lepidopterists only collect specimens as reference material for study and research and not as 'nuggets' in order to make money or to subsidise expeditions.

To summarise the pros and cons, I am deeply convinced that there is no real pathway to science without responsible collecting, which has to be accompanied by exact documentation of the locality, the circumstances of the collecting and all observational data. This needs concentration, responsibility and experience. Lepidopterists, be they professional or amateur, contribute significantly to our knowledge of biodiversity and the present changes that are taking place and their research has high priority value for Europe and for the rest of the world. Therefore they deserve to be treated and respected as valued members of society and they should not to be discriminated against. The numbers of specialists with a thorough knowledge of certain groups, or with an overall taxonomic/faunistic view of certain geographical areas, are nowadays rare and only a small body of experts are doing profound faunistic research; therefore, we urgently need more trained taxonomists and more local faunists. As a consequence, SEL is fighting for greater freedom for Lepidoptera collecting and our Society, as a responsible body, strongly opposes any additional useless restrictions.

GERHARD M. TARMANN

Die Psychidae des baltischen Bernsteins

THOMAS SOBCZYK[1] & MAX J. KOBBERT[2]

[1] Diesterwegstraße 28, 02977 Hoyerswerda, Germany; E-Mail: ThomasSobczyk@aol.com
[2] Franz-Marc-Weg 71, 48165 Münster, Germany; E-Mail: max.kobbert@t-online.de

Abstract. For the first time an overview is given on the Psychidae preserved in Baltic amber. All known psychid fossils from Baltic amber are larval cases. Some of them can be assigned to recent taxa: at the subfamily level to the Oiketicinae, Psychinae, and Typhoniinae; at the generic level to *Rebelia* Heylaerts, 1900 (Epichnopteriginae); and at the species level to *Dahlica triquetrella* (Hübner, 1813) (Naryciinae). Two of the species differ significantly from recent taxa and several inclusions are available for study. They are described as the ichnotaxa *Palaeopsyche secundum* gen. et sp. n. and *P. transversum* sp. n. The larval cases of *P. secundum* sp. n. are characterised by plant fragments attached to the spinned tube along the longitudinal axis. In contrast, in *P. transversum* sp. n. the plant fragments are attached at right angles on the longitudinal axis and almost horizontally protruding, which makes the case to appear almost bristly. Additionally, *P. secundum* sp. n. has the fragments fixed at one end only, so that they are movable and sometimes slightly sticking out. In contrast, *P. transversum* sp. n. has the plant fragments sometimes fixed in the middle only, so that both ends stick out, but they are obviously not movable. It can be excluded that the two described species are representatives of the two sexes of one species because (1) both species posteriorly have silken tubes, which is a characteristic of males only, and (2) such a distinct fragment attachment is unknown in recent species. The plant fragments are possibly grass.

Zusammenfassung. Erstmals wird ein Überblick über die im baltischen Bernstein erhaltenen Psychidae gegeben. Dabei handelt es sich ausschließlich um Raupensäcke. Einige von ihnen entsprechen rezenten Taxa der Unterfamilien Oiketicinae, Psychinae und Typhoniinae und auf Gattungsebene *Rebelia* Heylaerts, 1900 (Epichnopteriginae) sowie auf Artebene *Dahlica triquetrella* (Hübner, 1813) (Naryciinae). Zwei der Arten unterscheiden sich deutlich von den rezenten Arten und mehrere Inklusen konnten von ihnen untersucht werden. Sie werden als Ichnotaxa *Palaeopsyche secundum* gen. et sp. n. und *P. transversum* sp. n. beschrieben.

Einleitung

Die Zahl nachgewiesener Lepidoptera-Individuen im baltischen Bernstein ist gering. Der Anteil an den Insekten-Ordnungen wird mit 0,1 bis 1,1 % angegeben (Klebs 1910; Brues 1930; Théobald 1937; Skalski 1977). Für die Geologische Sammlung des Museums für Naturkunde und Vorgeschichte Dessau (www.dessau.de/print.asp?MenuID=1322) werden 2885 Insekteninklusen aus dem Bitterfelder Bernstein gelistet, von denen 5 Lepidoptera und 2 „Köchern“ zugeordnet werden (0,3 %). Für den dominikanischen Bernstein werden etwas höhere Werte genannt: 4,23 % (Henwood 1993) und 2,2 % (Poinar & Poinar 1999). Insgesamt wird die Anzahl bekannter Inklusen mit Schmetterlingen auf 500 geschätzt (Kristensen & Skalski 1998). Sie repräsentieren 71 beschriebene und zahlreiche unbeschriebene Taxa. Die überwiegende Anzahl der beschriebenen Taxa sind hierbei den Tineidae (19 Arten) und Oecophoridae (17 Arten) zugeordnet, wobei Kristensen & Skalski (1998) darauf hinweisen, dass die Familienzuordnung teilweise nicht in Übereinstimmung mit heutigen Konzepten steht.

In der Literatur finden sich zahlreiche Hinweise auf Psychidensäcke im baltischen Bernstein (Bachofen-Echt 1949; Kusnezov 1941; Poinar 1992). Der Begriff Sack leitet sich vom deutschen Namen der Familie Psychidae „Sackträger“ ab. Bei den durch die Larven hergestellten Gehäusen handelt es sich im eigentlichen Sinne nicht um Säcke, da sie auf beiden Seiten offen sind. Die Bezeichnung Köcher ist viel treffender und wird für Köcherfliegen (Trichoptera) mit zum Teil ähnlichem Bauplan der Gehäuse verwendet (Wichard et al. 1995). Ebenso ist dieser Begriff in der Literatur über Bernsteininklusen auch für Lepidopteren fixiert (Weitschat & Wichard 1998). Im Folgenden wird analog zur entomologischen Literatur (z.B. Sauter & Hättenschwiler, 2004) der Begriff Säcke verwendet.

Beschrieben wurde aus dem baltischen Bernstein bislang eine Psychide nach einem Sack, *Sterrhopteryx pristinella* Rebel, 1934 (Abb. 1). Diese den Oiketicinae zuordenbare Inkluse lässt sich allerdings nicht eindeutig der Gattung *Sterrhopteryx* Hübner, 1825 zuordnen. Demgegenüber ist der Anteil und die Vielfalt von Larven-Säcken im Verhältnis zu anderen Lepidoptereninklusen im baltischen Bernstein jedoch bemerkenswert hoch. Eine größere Anzahl Psychidensäcke ist bei Kobbert (2005) neben Säcken der Tineidae (Abb. 2) und weiterer Familien abgebildet. Die vorliegende Arbeit soll einen Überblick über die Vielfalt der im Bernstein vorkommenden Psychidensäcke geben und einen Bezug zur rezenten Fauna herstellen.

Die Kenntnisse der Bernstein-Psychidae beziehen sich gegenwärtig ausschließlich auf Sackfunde. Die Wahrscheinlichkeit, Imagines der Psychidae als Inklusen zu finden, ist äußerst gering. Ihre Lebensdauer ist sehr kurz und liegt oft unter einem Tag. Die Männchen haben verkümmerte Mundwerkzeuge und können keine Nahrung aufnehmen. Ihr Flug wird in der Regel ausschließlich durch das Pheromon der Weibchen gesteuert. Die Weibchen vieler Gattungen sind flügellos und verbleiben im Sack, sind also in Inklusen unsichtbar, oder auf dem Sack, müssten also zum Zeitpunkt des Einschlusses eben geschlüpft sein. Zur Verpuppung werden die Säcke angesponnen, sind also zum Schlupfzeitpunkt unbeweglich. Die Chance, dass an diesem Ort genau zu diesem Zeitpunkt Harz austritt und den Sack umschließt besteht kaum.

Sauter & Hättenschwiler 1991 unterteilen die palaearktischen Psychidae in 7 Unterfamilien. Eine weitere Unterfamilie (Scoryoditiinae) ist aus Neuseeland bekannt (Hättenschwiler 1989). Als typisch für Psychidensäcke geben Sauter & Hättenschwiler (2004) folgende Merkmale an:

- Vorder- und Hinterende sind morphologisch unterscheidbar.
- Durch die vordere Öffnung kann die Raupe den Kopf und die Brustsegmente herausschieben und sich mit Hilfe der Brustbeine bewegen, während der hintere Teil im
- Sack verbleibt und die Bauchbeine diesen festhalten.
- Das Hinterende des Sackes dient der Kotabgabe und später dem Schlüpfen der Imagines.
- Die Säcke sind im Querschnitt rund, rundlich oder oval, bei einigen Unterfamilien dreieckig mit meist deutlichen Kanten.

Die Untersuchungen von Sauter & Hättenschwiler (2004) beziehen sich auf die palaearktische Fauna, die nur etwa ein Viertel der bekannten Psychidae-Arten ausmacht. Diese Merkmale weisen jedoch alle bekannten Psychidae-Säcke auf und können somit als familientypisch gelten.

Psychidae sind nicht die einzigen Lepidoptera, deren Larven Säcke konstruieren. Vor allem bei den Tineidae und den Coleophoridae sowie einigen Oecophoridae ist diese Fähigkeit vorhanden. Bei den Tineidae besteht der Sack aus einem Gespinst, das mit einzelnen Partikeln belegt ist. Beide Sackenden stimmen in der Form überein und sind gleich gebaut. Die Säcke sind röhrenförmig, sie können auch abgeflacht und mit dachförmig erweiterten Enden versehen sein. Sie sehen dann bilateral symmetrisch aus. Die Raupen fressen Algen und Flechten oder auch tierische Produkte. Bei den Coleophoridae sind die Säcke bilateralsymmetrisch gebaut und Vorder- und Hinterende deutlich unterschiedlich gestaltet. Es handelt sich um minierende Arten. Einige Arten der Incurvariidae, Prodoxiidae und Adelidae weisen in den ersten Larvenstadien ebenfalls Säcke auf, diese sind flach und zweikantig (Sauter & Hättenschwiler 2004).

Material und Methoden

Ausgewertet wurden insgesamt 126 Säcke der Sammlungen Kobbert und Sobczyk. Zwei Drittel der Säcke konnten der Familie Psychidae zugeordnet werden. Dies sind aus der Sammlung Kobbert 71 Inkusen mit den Sammlungsnummern T103, T144, T145, T183, T194, T195, T197, T211, T219, T221, T231, T232, T269, T279, T314, T316, T322, T338, T339, T376, T389, T416, T430, T439, T452, T482, T491, T517, T518, T519, T529, T531, T543, T557, T602, T603, T604, T605, T606, T608, T609, T610, T611, T612, T618, T648, T650, T651, T663, T664, T665, T666, T667, T669, T670, T697, T703, T704, T705, T706, T707, T708, T709, T710, T722, T723, T724, T725, T726, T727, T729. Aus der Sammlung Sobczyk wurden 14 Inklusen von Psychidae mit der Bezeichnung 004TS, 006TS, 008TS, 009TS, 014TS, 015TS, 016TS, 021TS, 022TS, 023TS, 024TS, 026TS, 027TS, 041TS untersucht.

Weitere Inklusen gehören zu den Tineidae, Adelidae, vermutlich auch Diptera und Coleoptera, einige sind nicht zuordenbar. Zum Vergleich wurden Säcke von Psychiden aus dem Dominikanischen Bernstein (T512, T513 coll. Kobbert, ein Sack einer Oiketicinae aus coll. Hättenschwiler) und dem madagassischen Kopal (065TS coll Sobczyk) untersucht.

Die taxonomische Zuordnung der Säcke aus dem baltischen Bernstein folgt im Wesentlichen dem Bestimmungsschlüssel für die Säcke rezenter Psychidae von Sauter & Hättenschwiler (2004). Dabei bestehen die folgenden Schwierigkeiten:

Nicht alle Gehäuse mit rundem Querschnitt sind von Psychiden hergestellt (bei rezenten Arten ist eine Zuordnung meist zweifelsfrei möglich, wenn die Gehäuse geöffnet und die Larven oder deren Fragmente oder die Puppen/Exuvien untersucht werden).

Die Anzahl landbewohnender Trichoptera-Larven ist heute gering, doch können deren Köcher gelegentlich nicht von den Säcken der Psychiden unterschieden werden. Inwieweit zur Zeit der Bernstein-Lebensgemeinschaften Trichopteren-Larven an das Landleben angepasst waren, ist unbekannt. Auch bei Trichopteren ist die sichere Determination und Unterscheidung der Larven zu denen der Psychidae zweifelsfrei möglich.

Es ist denkbar, dass Psychiden mit abweichendem Sackbau in der Bernsteinfauna vertreten waren, die heute ausgestorben sind.

Es ist nicht ausgeschlossen, dass weitere Arthropoden-Taxa des Eozäns Säcke bauten, die denen heutiger Psychidensäcke ähneln.

Die Säcke zeigen eine erhebliche Variabilität, die manchmal mit dem in der Umgebung des Nahrungshabitates vorhandenem Baumaterial korelliert. Die hier untersuchten Säcke weisen zum überwiegenden Teil eine gute Übereinstimmung zur rezenten Fauna auf, wobei sie nicht zwangsläufig mit rezenten Taxa identisch sein müssen. Soweit möglich, wird die Bernsteinfauna höheren taxonomischen Ebenen zugeordnet.

Die Internationalen Nomenklaturregeln (ICZN, 1999) sehen im Artikel 1.2.1 für „names based on the fossilized work of organisms" den Begriff des Ichnotaxons vor. Dies ist in der vorliegenden Arbeit anzuwenden, da von den Psychidae ausschließlich der Sack im Bernstein erhalten ist, wobei die Larve möglicherweise im Sack enthalten oder teilweise sichtbar ist, aber keine ausreichenden morphologischen Merkmale sichtbar sind.

Eine Beschreibung von Säcken als Ichnotypen erscheint nur dort sinnvoll, wo keine vergleichbaren rezenten Formen bekannt sind. Wenn mehrere Inklusen vorliegen, kann ausgeschlossen werden, dass es sich um Individuen mit zufälliger Abweichung in der Struktur und dem verwendeten Baumaterial handelt.

Ergebnisse

Selbst wenn man die bei Kristensen & Skalski (1998) geschätzte Zahl von 500 Lepidoptereninklusen um die Anzahl der hier zuordenbaren Säcke und neuer Funde ergänzt, sind Psychidae mit mehr als 10 % an den im baltischen Bernstein dokumentierten Lepidoptera vertreten. Von den derzeit beschriebenen etwa 160.000 rezenten Lepidopterenarten entfallen weniger als 1 % auf die Psychidae, von denen etwa 1200 valide Arten bekannt sind (Sobczyk, unpubl.).

Die weitaus überwiegende Zahl der untersuchten Gehäuse weist eine Größe unter einem Zentimeter auf (Abb. 13). Die Größenverteilung ähnelt jener der anderen Arthropoden-Familien und kann wohl ausschließlich darauf zurückzuführen sein, dass vor allem kleine Arten durch den klebrigen Harz nachhaltig festgehalten wurden und die Chance des vollständigen Einschlusses und damit ausbleibender Verwitterung deutlich größer war.

Auch unter heutigen Verhältnissen finden sich an Kiefernharz z.B. Säcke von *Siederia pineti* (Zeller, 1852) und *Taleporia tubulosa* (Retzius, 1783), einzeln auch *Bacotia claustrella* (Bruand, 1845). Während einer Untersuchung 1982 in der Dübener Heide (Sachsen, Deutschland) konnten auf Harzungsflächen insgesamt 17 von Harz umschlossene Säcke der oben genannten Arten registriert werden.

Von den Unterfamilien sind mit Sicherheit die Oiketicinae gut im baltischen Bernstein dokumentiert (Abb. 3, 4, 5), ebenso sind einige Säcke den Psychinae zuordenbar, einige stimmen gut mit Säcken der rezenten Gattung *Proutia* Tutt, 1899 überein (Abb. 6). Zu den Typhoniinae werden einige Arten mit Sandbestandteilen gestellt (Abb. 7, 8). Von den Epichnopteriginae sind mehrere der Gattung *Rebelia* sehr ähnliche Säcke dokumentiert. Erstmals nachgewiesen werden konnten im Rahmen dieser Untersuchung Säcke mit dreieckigem Querschnitt im baltischen Bernstein. Diese sind für die Unterfamilien Taleporiinae und Naryciinae sowie den Scoriodytiinae typisch. Die Taleporiinae und Naryciinae stellen in Mittel- und Nordeuropa die überwiegende Zahl der waldbewohnenden und direkt an Stämmen lebenden, oft lichenophagen Arten dar und sind in tropischen Gebieten weniger häufig. Während von den Taleporiinae und

Scoriodytiinae Belege aus dem baltischen Bernstein fehlen, stimmen zwei der Säcke (Abb. 9, 10) völlig mit denen der rezenten *Dahlica triquetrella* (Hübner, 1813) aus der Unterfamilie der Naryciinae überein.

Beschreibung von Ichnotaxa

Im Folgenden wird eine Gattung mit 2 Arten neu beschrieben, bei denen auf Grund eines deutlich abweichenden Sackbaus eine Zuordnung zu rezenten Formen auch unter Einbeziehung der tropischen Fauna nicht möglich ist. Die Säcke der tropischen Arten wurden im Deutschen Entomologischen Institut Müncheberg, dem Museum der Humboldt Universität Berlin, dem Museum National d´Histoire Naturelle Paris, im National History Museum London und der Zoologischen Staatssammlung München untersucht. Ebenso ergab die Literaturrecherche und das umfangreiche Material zur Bearbeitung der Psychidae der Orientalis (Sobczyk, 2008) keinerlei Hinweise auf ähnliche Arten.

Palaeopsyche gen. n.

Gattungstypus: *Palaeopsyche secundum* sp. n.
Typenlokalität: Baltikum (Russland und Polen).

Beschreibung. Säcke lang gestreckt, von rundem Querschnitt, posterior sich geringfügig verjüngend, aus feinen Gespinstfäden bestehend. Vermutlich relativ weich und nicht druckfest. Dicht mit sehr schmalen Pflanzenfasern und -teilen (vermutlich Gräser) bedeckt. Diese besonders im anterioren Drittel konzentriert. Anteriore und posteriore Öffnung rund, mit geradem Rand, aus lateraler Sicht etwa rechtwinklig zur Längsachse.
Diagnose. Durch die extrem feine Struktur des verwendeten Baumaterials in Verbindung mit dem lang gestreckten Habitus von allen bislang bekannten fossilen und rezenten Gattungen der Psychidae deutlich verschieden. Es wurden neun solcher Inklusen mit identischer Bauart nachgewiesen, die zudem eine unterschiedliche Größe aufweisen. Es ist somit auszuschließen, dass es sich um eine zufällige Bildung in Ermangelung anderen Baumaterials handelt. Rezente Unterfamilien mit Säcken von rundem Querschnitt sind Oiketicinae, Psychiinae, Typhoniinae, Epichnopteryginae. Eine Zuordnung zu einer dieser Unterfamilien ist ohne Vorliegen von Imagines oder Larven nicht möglich.
Etymology. palaios (griech.) = alt, Psyche = (griech.) Geist.

Palaeopsyche secundum sp. n. Abb. 11

Typenlokalität: Baltikum (Russland und Polen).
Material. Holotypus: T666: Bernstein 28 mm lang, Sack 18 mm; in coll. Kobbert. Der Holotypus befindet sich in der Sammlung Kobbert und gelangt später in die Bernsteinsammlung des Staatlichen Museums für Naturkunde in Stuttgart. – Paratypen: T349: Bernstein 38 mm lang; Sack 10 mm lang. Mit feinen starren Pflanzenfasern bedeckt,

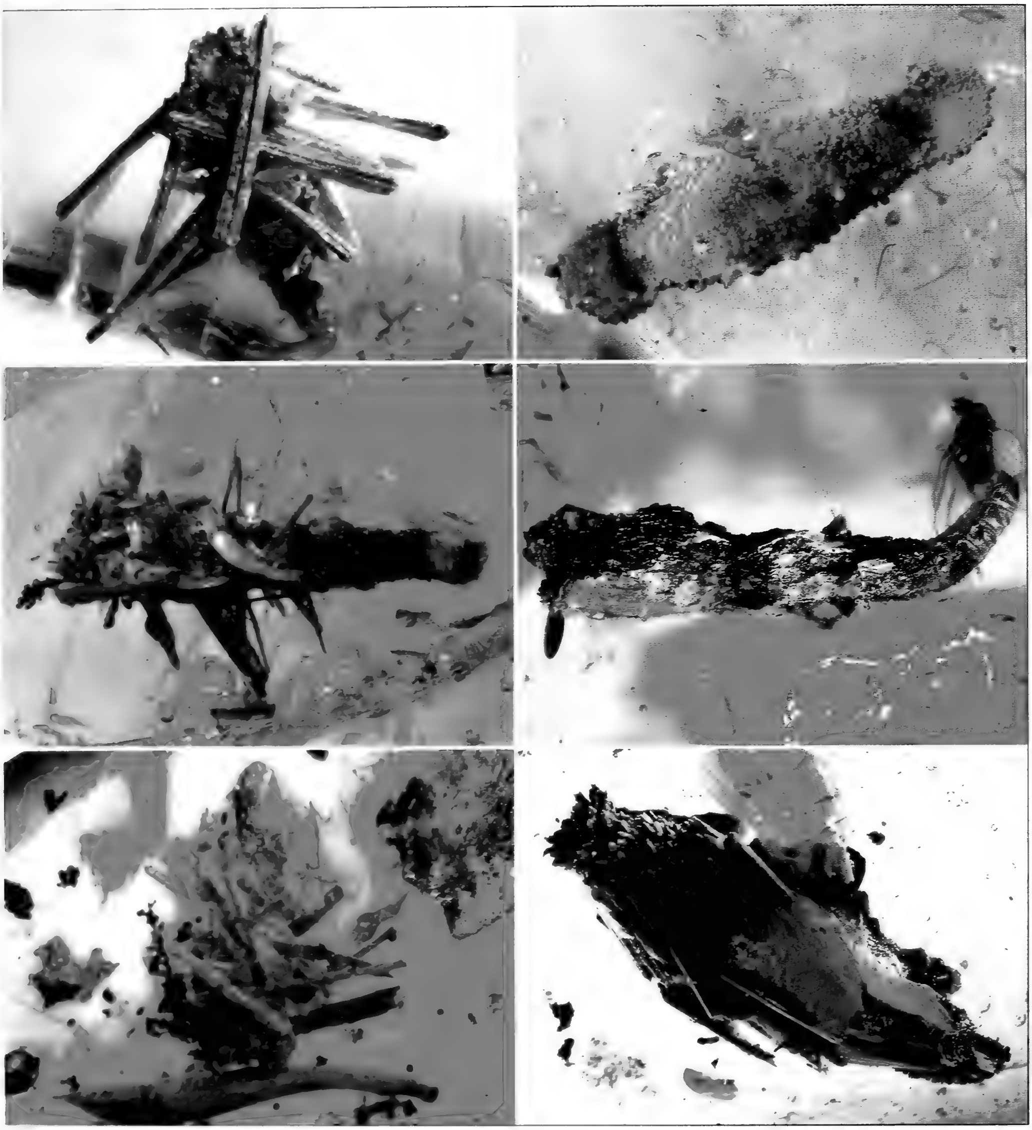


Abb. 1–6. Säcke von Lepidopteren in baltischem Bernstein. **1.** „*Sterrhopteryx*“ *pristinella* Rebel, 1934, L 4,2 mm, B 5,0 mm, Baumaterial: Nadelfragmente (T144, coll. Kobbert). **2.** Tineidae (*Eudarcia* sp.), L 6,5 mm, B 1,8 mm, Baumaterial: Fraßspäne (T069, coll. Kobbert). **3.** Oiketicinae, L 8,0 mm, B 4,5 mm, Baumaterial: Nadeln und Fraßspäne (T279, coll. Kobbert). **4.** Oiketicinae, mit Raupe, L 8,5 mm, B 2,5 mm, Baumaterial: vermutlich Borkenpartikel (T314, coll. Kobbert). **5.** Oiketicinae, L 8,0 mm, B 6,5 mm, Baumaterial: Nadelfragmente und Fraßspäne (T609, coll. Kobbert). **6.** *Proutia* sp., L 9,0 mm, B 4,0 mm, Baumaterial: Borkenpartikel (T338, coll. Kobbert).

diese vorn schräg nach hinten abstehend und etwa die Hälfte der Gesamtlänge des Sackes, hinten anliegend und deutlich kürzer. – T618: Bernstein 49 mm lang; Sack 19,4 mm lang; Pflanzenfragmente vorn nur an einem Ende angeheftet und kürzer als bei den beiden anderen Säcken (2–3 mm lang). Vom Habitus sonst den beiden anderen gleichend. Syninkluse Weberknecht mit 25 mm langem Bein. – T557: Bernstein 32 mm

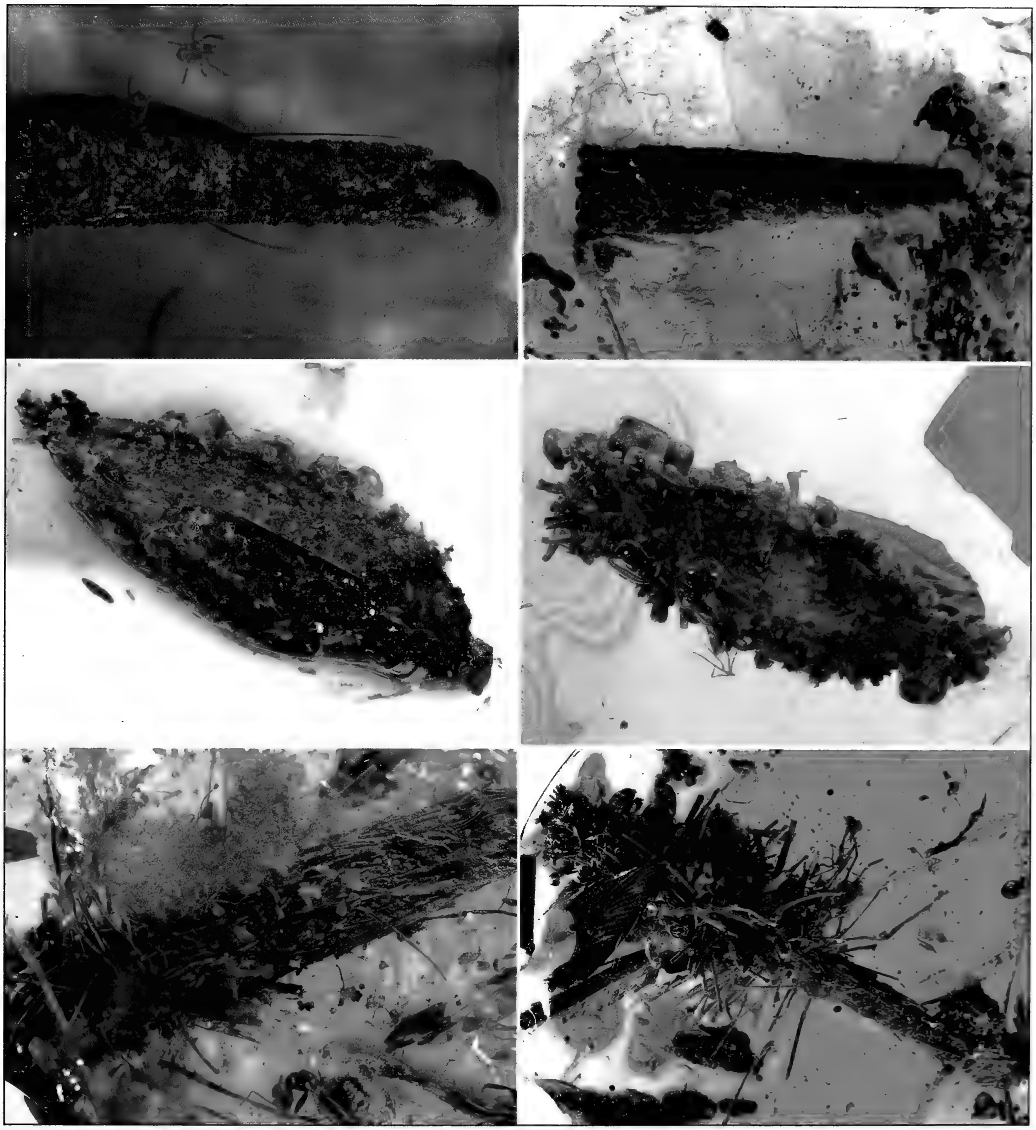


Abb. 7–12. Säcke von Psychidae. **7.** Typhoniinae mit Raupe, L 5,7 mm, B 1,0 mm, Baumaterial: Fraßspäne (T145, coll. Kobbert). **8.** Typhoniinae, L 7,0 mm, B 1,7 mm, Baumaterial: Fraßspäne (T194, coll. Kobbert). **9.** *Dahlica triquetrella*, L 7,0 mm, B 2,7 mm, Baumaterial: Fraßspäne, Insektenreste (T663, coll. Kobbert). **10.** *Dahlica triquetrella*, L 6,0 mm, B 2,5 mm, Baumaterial: Sand Insektenreste (T729, coll. Kobbert). **11.** *Palaeopsyche secundum*, sp. n. Holotype, L 18 mm, B 20 mm, Baumaterial: grasartige Fragmente (T666, coll. Kobbert). **12.** *Palaepsyche transversum* sp. n. Holotype, Baumaterial: grasartige Fragmente, Blatt- und Insektenreste (T316, coll. Kobbert).

lang; Sack 21 mm lang. Raupe vorn herausschauend. Vorn mit abstehenden 4 bis 5 mm langen Fasern bekleidet, distales Drittel mit nicht näher erkennbaren feinem Detritus oder Kot bekleidet, mit nur einzelnen kurzen Fasern durchmischt. (alle in coll. Kobbert). – ST 15: Bernstein 20 mm lang; Sack 8 mm lang Pflanzenfragmente vorn nur an einem Ende angeheftet und kürzer als bei den beiden anderen Säcken (2–3 mm lang).

Vom Habitus sonst den beiden anderen gleichend. Syninkluse Abdomen einer Ameise (in coll. Sobczyk).

Beschreibung. Sacklänge 8–21 mm. Sack anliegend mit sehr feinen Pflanzenfasern bedeckt, diese meisten zwischen 3–5 mm lang, im Querschnitt rund, 0,1–0,2 mm Durchmesser. Ende weniger dicht bedeckt (teilweise mit Schlupfröhre der Männchen), Einzelne Pflanzenfasern lose und abstehend.
Differentialdiagnose. Vgl. *P. transversum*, sp. n.
Etymology. secundum (lat.): längs. Der Name bezieht sich auf die Anordnung der Pflanzenfragmente auf dem Sack.

Palaeopsyche transversum sp. n. **Abb. 12**

Typenlokalität: Baltikum (Russland und Polen).
Material. Holotypus: T316, Bernstein 48 mm lang; Sack 26 mm lang; in coll. Kobbert. Der Holotypus befindet sich in der Sammlung Kobbert und gelangt später in die Bernsteinsammlung des Staatlichen Museums für Naturkunde in Stuttgart. Paratypen: T710, Bernstein 37 mm lang; 15 mm lang (in coll. Kobbert), 021TS Bernstein 27 mm, Sack 13 mm lang (in coll. Sobczyk).

Beschreibung. Holotypus: T316: Vordere Hälfte mit deutlich quer gelegten Pflanzenfragmenten, vor allem kurzen starren Fasern und kurzen Halmstücken (?) hinten dicht längs angeheftete kurze Fasern an der schmalen, lang ausgezogenen Röhre. Größter bisher aus dem Bernstein bekannter Larvensack! – Paratypus: T710: Bernstein 37 mm lang; 15 mm lang, ähnlich dem vorherigen, doch vorn ausschließlich mit sehr feinen, geraden Fasern, s-förmig gekrümmt (vermutlich durch den Einschluss), (in coll. Kobbert). 021TS: Sack 13 mm, an beiden Enden angeschliffen, pflanzliche Teile 2–5 mm lang, im Querschnitt kreisrund, Durchmesser ca. 0,05–0,15 mm. Die Fragmente scheinen auf die jeweilige Länge abgebissen zu sein und sind deutlich abstehend. Gespinströhre distal Durchmesser 2 mm (angeschliffen).
Diagnose. Gesamthabitus der beiden Taxa ähnlich. Während bei *P. secundum* sp.n. die Pflanzenfragmente an der Gespinströhre anliegend oder zumindest deutlich nach hinten gerichtet sind, wird bei *P. transversum* sp.n. das Material überwiegend quer verbaut. Die Fragmente sind somit fast waagerecht abstehend, der Sack erhält dadurch ein fast struppiges Aussehen. Bei *P. secundum* sp.n. sind die Fragmente an nur einem Ende angesponnen und dadurch beweglich. Durch Lageveränderung im Bernstein können die lose angesponnen Pflanzenfragmente daher etwas abstehen. Bei *P. transversum* sp.n. hingegen sind Fragmente teilweise auch in der Mitte angesponnen, so dass beide Enden abstehen. Sie sind offensichtlich nicht beweglich angesponnen. Es wird ausgeschlossen, dass es sich um Säcke der beiden Geschlechter einer Art handelt, da bei beiden Arten Säcke in Gespinströhren enden, die nur den Männchen eigen sind. Ebenso wenig ist bei rezenten Arten eine derartig unterschiedliche Befestigungstechnik innerhalb einer Art mit identischem Baumaterial bekannt. Bei den Fragmenten handelt es sich möglicherweise um Gräser oder grasartige Fragmente.

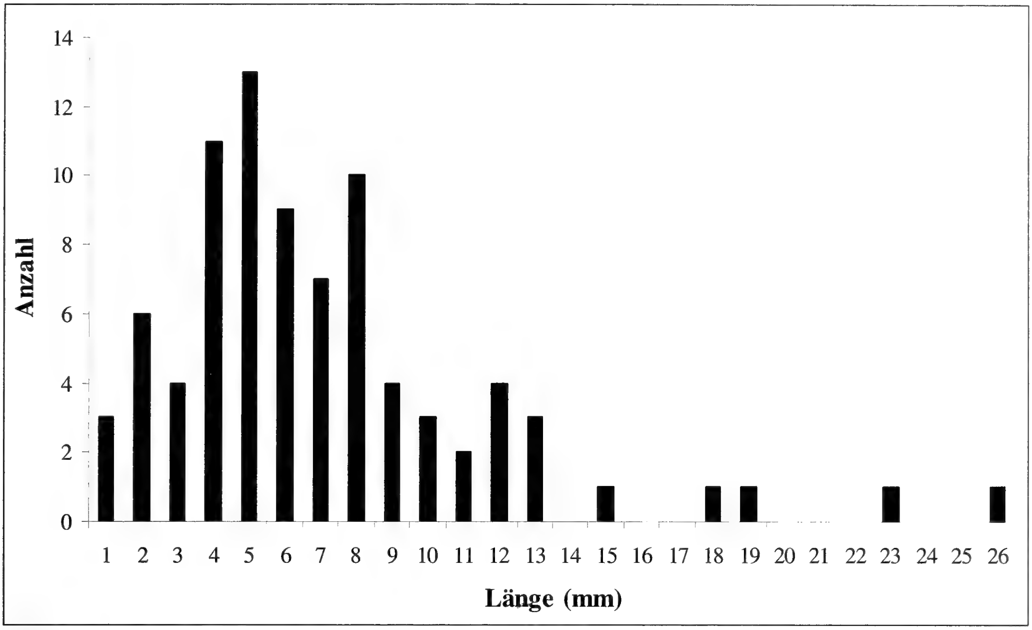


Abb. 13: Längenverteilung der untersuchten Psychiden-Säcke im baltischen Bernstein.

Etymology. transversum (lat.) = quer. Der Name bezieht sich auf die Anordnung der Pflanzenfragmente auf dem Sack.

Diskussion

Auffällig ist die verhältnismäßig geringe Anzahl kleiner Säcke von 1–3 mm Länge, die im Wesentlichen dem ersten Larvenstadium zuzuordnen sind. Die Ausbreitung der Psychidae erfolgt vor allem durch Balloning der frisch geschlüpften Raupen mit ihrem ersten Sack. Die Chance, dabei weitab von ihrem Schlupfort z.B. an Harz festzukleben ist relativ groß. Der Lufttransport wird aktiv vorbereitet, indem die Larve an einen erhöhten Platz kriecht und sich an einem Gespinstfaden herablässt, der dann durch den Wind mitsamt der Raupe verweht wird (Beobachtung Sobczyk). Diese passive Verbreitung würde auch Arten in Bernstein fixieren, die in größerer Entfernung (bis mehrere hundert Meter) vom Habitat vorkommen.

Demgegenüber sind große Säcke unterproportional erhalten, so dass der überwiegende Teil von ihnen unmittelbar im Nahrungs- oder Verpuppungsbiotop fixiert worden zu sein scheint.

Ein Großteil der heute vorkommenden Arten besiedelt Offenlandhabitate. Nur wenige Arten sind ausschließlich an Waldstrukturen gebunden. Da in vielen Fällen kleine Blattfragmente verbaut wurden, die nicht von verholzten Pflanzen stammen und bei einigen der Säcke obligatorisch Sandfragmente eingesponnen sind, kann darauf geschlossen werden, dass solche offenen Flächen auch in den Habitaten der Bernsteinfauna vorhanden gewesen sein müssen.

Danksagung

Herzlichen Dank an Hans Werner Hoffeins (Hamburg) und Angelika Hesse (Dessau-Rosslau) für wertvolle Informationen in Zusammenhang mit der Bernsteinfauna sowie Hans Riefenstahl (Hamburg) und Matthias Nuß (Dresden) für Literaturbeschaffung und Diskussion. Weiterhin danken wir Peter Hättenschwiler (Uster, Schweiz) für die Möglichkeit der Untersuchung einer Inkluse aus dem dominikanischen Bernstein.

Literatur

Bachofen-Echt, A. 1949. Der Bernstein und seine Einschlüsse. – Springer, Wien. Neuaufl. J. Wunderlich Verlag, Straubenhardt 1996.

Brues, C. F. 1933. Progressive change in the insect population of forests since the early tertiary. – American Naturalist **67**: 385–406.

Hättenschwiler, P. 1989. Genus *Scoriodyta* Meyrick, 1888, a new subfamily and description of new species and forms. – New Zealand Journal of Zoology **16**: 51–63.

ICZN (International Commission for the Zoological Nomenclature). 1999. International Code of Zoological Nomenclature, adopted by the International Union of Biological Sciences, 4th edition. – 232 S. London (International trust for Zoological Nomenclature).

Klebs R. 1910. Über Bernsteineinschlüsse im Allgemeinen und die Coleopteren meiner Bernsteinsammlung. – Schriften der Königlichen physikalisch-ökonomischen Gesellschaft zu Königsberg **51**: 217–242.

Kobbert, M. J. 2005. Bernstein –Fenster in die Urzeit. – Planet Poster Edition. Dortmund, 224 Seiten.

Kraus, O. 2001. Internationale Regeln für die Zoologische Nomenklatur, 4. Auflage. – offizieller deutscher Text. – Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg, Neue Folge **34**: 1–232.

Kristensen, N. & A.W. Skalski 1998. Palaeontology and phylogenie. S. 7–25. *In*: N. P. Kristensen (Hrsg.). Lepidoptera, Moths and Butterflies. Volume 1: Evolution, systematics and biogeography. – *In*: M. Fischer (Hrsg.): Handbook of Zoology. Volume IV Arthropoda: Insecta, Part. 35. – Walter de Gruyer, Berlin.

Kusnezov, N. J. 1941. A revision of the amber lepidoptera. – Académie des Sciences de L'URSS, Moscou, 137 S.

Poinar, G. O. 1992. Life in Amber. – 368 S. Stanford University press.

Poinar, G. O. & R. Poinar (1999. The amber forest: a reconstruction of a vanished world. – 239 S., Princeton University Press, Princeton, New Jersey.

Rebel, H. (1934): Bernstein Lepidopteren. – Paläobiologica **6**: 1–16.

Sauter, W. & P. Hättenschwiler (1991): Zum System der palaarktischen Psychiden (Lep., Psychidae). 1. Teil: Liste der palaearktischen Arten. – Nota lepidopterologica **14** (1): 69–89.

Sauter, W. & P. Hättenschwiler 2004. Zum System der palaearktischen Psychiden (Lep., Psychidae). 3. Teil: Bestimmungsschlüssel für die Säcke. – Nota lepidopterologica **27** (1): 59–70.

Théobald, N. 1937. Les insectes fossiles des terrains oligocènes de France. – G. Thomas, Nancy, 473 + [1] p.

Skalski, A. W. 1977. Studies on the Lepidoptera from fossil resins. Part I. General remarks and description of a new genera and species of the families Tineidae and Oecophoridae from the Baltic amber. – Prace Muzeum Ziemi **26**: 3–24, 10 pl..

Sobczyk, T. 2008. Beiträge zur Kenntnis der orientalischen Psychidae (Lepidoptera). I. Taxonomische Korrekturen und Beschreibung neuer Arten aus Thailand, Myanmar und von den Philippinen. – Entomologische Zeitschrift **118** (5): 195–206.

Weitschat, W. & W. Wichard 1998. Atlas der Pflanzen und Tiere im Baltischen Bernstein. 256 S., Pfeil, München.

Wichard, W., W. Arens & G. Eisenbeis 1995. Atlas zur Biologie der Wasserinsekten. – Fischer, Stuttgart 338 S.

Records of larvae of *Eupithecia lentiscata* Mabille, 1869 on Sardinia (Geometridae)

Bernd Müller [1] & Peder Skou [2]

[1] Weissdornallee 13, D-13158 Berlin, Germany; e-mail: geobernd@gmx.de
[2] Kirkeby Sand 19, DK-5771 Stenstrup, Denmark; e-mail: apollobooks@vip.cybercity.dk

Abstract. The first record of the little known *Eupithecia lentiscata* Mabille, 1869 on Sardinia is reported. Two forms of the larva, the adult moth, and the habitat are illustrated, and the breeding method and wing pattern characters of the moth are described. Remarks on three other geometrid species found in the same habitat are added.

Zusammenfassung. Es wird über den Erstnachweis der wenig bekannten *Eupithecia lentiscata* Mabille, 1869 auf Sardinien berichtet. Zwei Raupenformen, Falter und Lebensraum werden abgebildet, der Zuchtverlauf und typische Merkmale des Falters beschrieben. Bemerkungen über drei Begleitarten ergänzen die Arbeit.

The Mediterranean *Eupithecia lentiscata* Mabille, 1869 is one of the geometrid species that has been most rarely recorded since it was discovered on Corsica. This is probably caused by the unusual flying time for a *Eupithecia* species, which is in the middle of the winter. Mironov (2003) mentions the adults flying from January to early March.

In their checklist Raineri & Zangheri (1995) did not record this species from Italy, so the records from Corsica were the only known ones for a very long time (Müller 1996). In 2002 the species was found for the first time in Italy by the record of one caterpillar on Sardinia (8 km E of Porto Tórres, Platamona Lido, 5 m, 10. iv. 2002, Peder Skou leg.). This record was included in Mironov (2003) along with that of one specimen from Monemvasia on the southern end of the Peloponnes peninsular in Greece.

During a collecting trip from 4th to 18th April 2007 on Costa Smeralda, Sardinia, three fully grown larvae of *Eupithecia lentiscata* were found by Golfo Aranci (6. iv. 2007, Bernd Müller leg.).

The literature mentioned that *Eupithecia lentiscata* feeds on the inflorescences of the mastic tree, *Pistacia lentiscus* (Anacardiaceae) (Mabille 1869, 1872; Dietze 1910, 1913; Mironov 2003). We obtained caterpillars by carefully beating the inflorescences over an umbrella. The caterpillars fed only on the flowers and pupated after just a few days in the breeding case in a cocoon between remains of the food. The pupae were taken out of these and placed between pieces of tissue in a pupae box. There they spent the summer and the following winter, and were sprayed with water only now and then. In order to imitate the mild winter climate on the coasts of Sardinia, the pupae box was kept under cool conditions, but not below -2 °C. All four pupae hatched as adult moths in late January 2003 (1 female) and on 21, 25 and 26 January 2008 (1 crippled male and 2 well developed females, Fig. 1).

Further beating for caterpillars of *E. lentiscata* at other localities of Costa Smeralda in 2007 was negative, but resulted in caterpillars of the Geometridae species *Colotois pennaria* (Linnaeus, 1761), *Agriopis bajaria* (Denis & Schiffermüller, 1775), and *A. marginaria* (Fabricius, 1776). Until their pupation the larvae of these three spe-

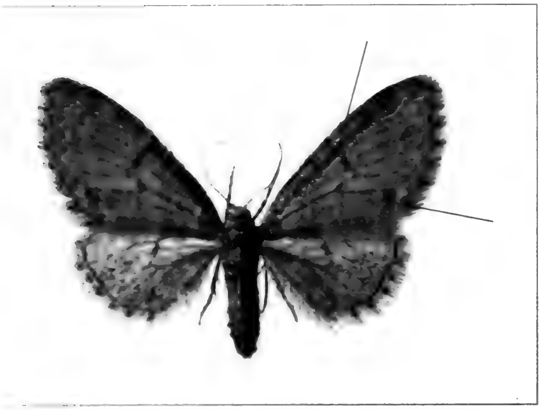


Fig. 1. Female of *Eupithecia lentiscata* Mabille, 1869. Sardinia, Golfo Aranci. Forewing length 10.5 mm, wingspan 18 mm.

cies were fed with flowers of *Pistacia lentiscus*, which appear to be a little known food-plant for the three species since Flamigni et al. (2007) only mention it for *A. bajaria*. During our search for caterpillars of *E. lentiscata* we noted that only a small proportion of the food-plants were flowering, i.e. only less than 10 % of the total number of plants.

The larva of *E. lentiscata* is very variable and occurs in two main forms, a green and a red one. Dietze (1910) shows on his excellent colour plates two green and one red form, that all differ a little in detail from the caterpillars from Sardinia (triangular spots less red-brown filled). Figure 2 shows a green caterpillar with a red-brown line on the back and red-brown filled triangular spots, that are pointing forwards. Figure 3 shows a reddish caterpillar with a similar red-brown pattern on the back. Both forms are very well camouflaged among the flowers of the food-plant.

There is hardly any material of *Eupithecia lentiscata* in public or private collections, and Mironov (2003) could only illustrate two males on his colour plates, including the holotype of the species, that was previously used by Dietze (1910) for his somewhat dark illustration. The material available now, i.e. the three females from Sardinia, resemble the holotype with a rather weak and poorly contrasting wing pattern. As in many *Eupithecia* species, the newly emerged adults are rather grey in their ground colour. Even if the specimens are kept in complete darkness, this colour slowly changes over decades to more brownish as can be seen on the nearly 140 years old holotype on the colour plate by Mironov (2003). However, two elements of the wing pattern are more or less visible on all specimens: Firstly, the narrow medial transverse line running through the discal spot and, secondly, the nearly right-angled dark area between cubital vein CuA2 and the inner margin on the forewing between the wavy line and the subterminal line, which is clearly visible on the specimen in Fig. 1. Apart from this the species seems to be somewhat variable in the distinctness of the wing pattern, and there may be a slight sexual dimorphism.

The habitat at Golfo Aranci is a coastal maquis with numerous *Pistacia lentiscus* on a hill of about 50 m in elevation (Fig. 4). It was surprising to find that the caterpillars were found on a sun exposed, but rather windy hill. No caterpillars were observed on the more shaded and moist parts of the hill. The habitat near Platamona Lido (Fig. 5) is a costal dune area overgrown with herbaceous plants, trees, and bushes of which *Pinus* spp. (Pinaceae)and *Juniperus oxycedrus* L. (Cupressaceae) were the dominant species. There were rather few *P. lentiscus* bushes, and the only one with flowers, where the caterpillar was found, was growing on the south side of the locality, exposed to the sun and rather protected against the wind.

Figs 2–3. Larva of *Eupithecia lentiscata* Mabille, 1869. **2.** Green form. **3.** Reddish form.

Figs 4–5. Habitat of *Eupithecia lentiscata* Mabille, 1869. **4.** Near Golfo Aranci, Sardinia. **5.** Near Porto Tórres, Platamona Lido, Sardinia.

Acknowledgements

We are thankful to Dr Vladimir Mironov, St. Petersburg, for his kind confirmation of the identification of the caterpillars and the male genitalia slide, based on the authors′ photos, and to Martin Corley, Faringdon, United Kingdom, for linguistic help.

References

Dietze, K. 1910. Biologie der Eupithecien. Teil 1 (Tafeln). – Friedländer & Sohn, Berlin.
Dietze, K. 1913. Biologie der Eupithecien. Teil 2 (Text). – Friedländer & Sohn, Berlin.
Flamigni, C., G. Fiumi & P. Parenzan 2007. Lepidotteri Eteroceri d'Italia, Geometridae Ennominae I. – Natura Edizioni Scientifiche, Bologna. 384 pp.
Mabille, P. 1869. Énumération monographique des Eupithécies de l'île de Corse (2^e partie). – Annales de la Société Entomologique de France **9** (4 sér.): 64–80.
Mabille, P. 1872. Recherches et observations lépidoptérologiques. – Annales de la Société Entomologique de France **2** (5 sér.): 489–502.
Mironov, V. 2003. Larentiinae II (Perizomini and Eupitheciini). – *In*: A. Hausmann (ed.), The Geometrid Moths of Europe **4**. – Apollo Books, Stenstrup. 463 pp., 16 pls.

Müller, B. 1996. Geometridae. – *In*: O. Karsholt & J. Razowski (eds.), The Lepidoptera of Europe, A Distributional Checklist. Pp. 218–249. – Apollo Books, Stenstrup.

Raineri, V. & S. Zangheri 1995. 90. Lepidoptera Drepanoidea, Axioidea, Geometroidea. – *In*: A. Minelli, S. Ruffo & S. La Posta (eds.), Checklist delle specie della fauna Italiana, parts 88–91. – Edizioni Calderini, Bologna. 43 pp.

Oviposition habitat and feeding behaviour of the dingy skipper (*Erynnis tages* (Linnaeus, 1758), in Schleswig-Holstein (North Germany) (Hepseriidae)

Anja Jäschke [1] & Detlef Kolligs [2]

[1] Institut für Geowissenschaften, Abteilung Biogeographie, Universitätstraße 30, 95447 Bayreuth
[2] Ökologie-Zentrum der Universität Kiel, Abteilung Landschaftsökologie, Olshausenstr. 75, 24118 Kiel; E-Mail: dkolligs@ecology.uni-kiel.de

Abstract. The habitat requirements of the dingy skipper (*Erynnis tages* (L., 1758), Hesperiidae), especially for oviposition, were unknown in Schleswig-Holstein, North Germany. In order to gain information on its environmental requirements, egg-laying females were observed in early June, 2006, at one location close to the town of Schleswig. Altogether, 62 egg depositions were recorded and different parameters were measured. The only host plants in this region are small, separated growing, non-flowering plants of *Lotus corniculatus* (L., 1753, Fabaceae) which were exposed to the sun. These observations point toward a narrow microclimatic preference of the butterfly in this area. Additional visiting of flowers by the imagines was observed. *Erynnis tages* seems to prefer yellow-flowering plants.

Zusammenfassung. Die Habitatansprüche des Leguminosen-Dickkopffalters (*Erynnis tages*) sind bisher wenig untersucht worden. Deshalb wurden Anfang Juni 2006 Weibchen bei der Eiablage in einer ehemaligen Kiesgrube nahe Schleswig in Norddeutschland beobachtet und unterschiedliche Parameter an den Eiablagestellen aufgenommen. Insgesamt konnten 62 Eiablagen beobachtet werden. Es wurden ausschließlich kleine, einzeln stehende, nicht blühende Pflanzen von *Lotus corniculatus* belegt, die gleichzeitig stark besonnt waren. Dies deutet auf eine enge mikroklimatische Einnischung des Falters in diesem Gebiet hin. Zusätzlich wurden die von den Imagines aufgesuchten Blütenpflanzen dokumentiert. *Erynnis tages* scheint gelb-blühende Pflanzen zu bevorzugen.

Introduction

In Schleswig-Holstein, North Germany, the dingy skipper (*Erynnis tages* (Linnaeus, 1758) is threatened with extinction. Formerly widespread in different types of nutrient-poor grasslands, it is now found in stable populations at only three sites (Kolligs 2003). *Erynnis tages* is also listed as highly endangered in adjacent Denmark (Stolze 2005).
In Central Germany oviposition and adult habitats in semi-dry calcareous grasslands have been analysed by Fartmann (2004). But for successful conservation and recolonisation of this species in Schleswig-Holstein, a detailed knowledge of the local egg-laying and larval habitat is essential, such as Asher et al. (2001) published for the conservation action plans in Great Britain. In contrast Fartmann & Hermann (2006) have shown that the knowledge needed for the conservation and recolonisation of most Central European butterfly species, including *E. tages,* is still insufficient.
Therefore, this paper uncovers the habitat requirements of *E. tages* in a part of Northern Germany, including the oviposition microhabitats as well as the feeding behaviour of the butterfly.

Material and methods

Study Area. The study was carried out near the city of Idstedt, close to the city of Schleswig (Schleswig-Holstein, North Germany) (Fig. 1a). The study area was for-

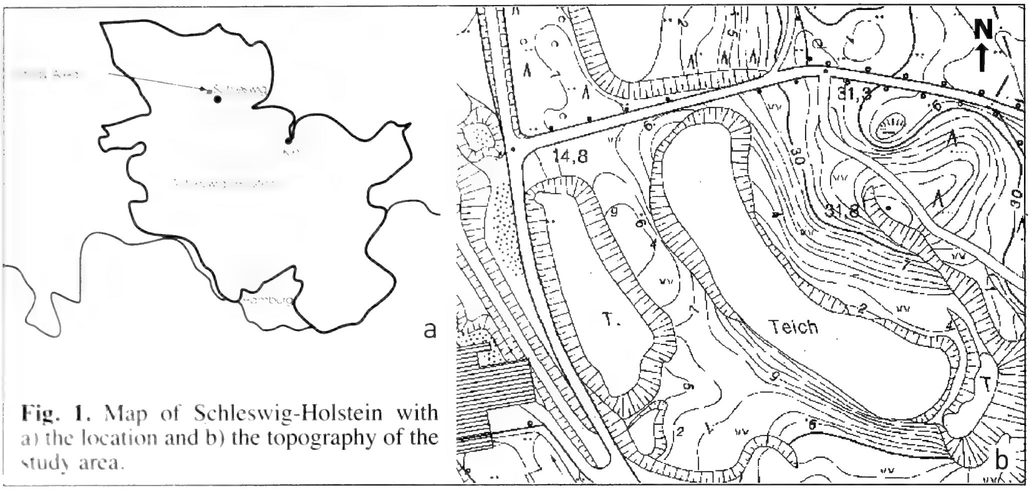


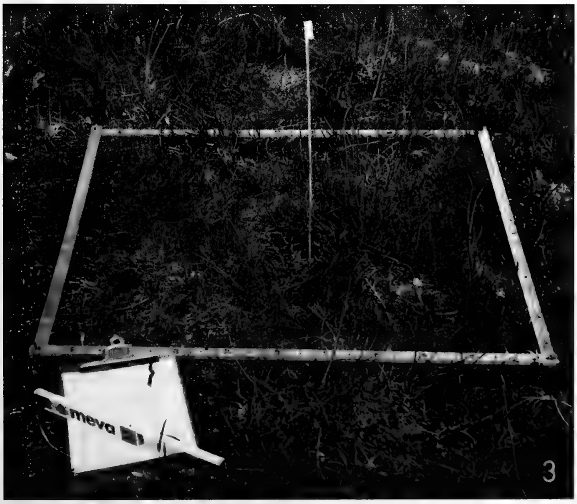
Fig. 1. Map of Schleswig-Holstein with a) the location and b) the topography of the study area.

merly used as a gravel pit. The butterfly had a scattered distribution on the site, reaching highest densities between two ponds (Fig. 1b). The study area was characterised by a nutrient-poor (oligotrophic) grassland community (e.g. *Agrostis capillaris* (L., 1753, Poaceae), *Anthyllis vulneraria* (L., 1753, Fabaceae), *Hieracium pilosella* (L., 1753, Asteraceae) and *Lotus corniculatus*) with shrubs (Fig. 2). The open parts were exposed to the sun, where different young trees were coming up (e.g. *Acer pseudoplatanus* (L., 1753, Aceraceae), *Betula pendula* (Roth, 1788, Corylaceae), *Crataegus monogyna* (Jacq., 1775, Rosaceae), *Quercus robur* (L., 1753, Fagaceae), and *Larix decidua* (Mill., 1768, Pinaceae).

Observation of oviposition. These observations were carried out from June 2 to June 8, 2006. The egg-laying analysis started with the pursuit of females, with care taken not to disturb them. When egg-laying was observed, the site was marked with a post. Following egg deposition, the female was pursued further, if possible. The observation was stopped after five minutes if the female did not lay additional eggs. Sample plots were established with the host plant in the center of the area. Each sample plot included one square meter around the egg-laying site (Fig. 3). The following environmental parameters were measured: 1. Growth form of the plant (single-shooted, oligo-shooted, young side shoot, extensive stand); 2. Plant height; 3. Oviposition height; 4. Mean vegetation height (three measurements, randomly); 5. Vegetation coverage (estimated, in 5% units), 6. Mean litter layer height (three measurements immediately at the covered plant).

Feeding behaviour of the adults. The feeding behaviour of *Erynnis tages* was observed during monitoring of the females. The plant species and the quantity of feeding observations were recorded.

Statistics. The statistical analysis was carried out with STATISTICA (Statsoft 1998). Data were tested on normal distribution with Kolmogorov-Smirnov-test. No normally distributed data were found so a Spearmen-rank correlation was calculated for all measured parameters.



Figs 2–3. Study area. **2.** Habitat between the two lakes; view from the south. **3.** Marked egg-laying plant in the centre of the sample plot.

Results

Feeding observations. The butterflies were observed visiting flowers primarily in the morning and after oviposition. During phases without sun, the butterflies rested on the vegetation. Yellow-flowered plants were the most frequented (515 of 574; 89.7%). Feeding was observed less often on blue-violet flowers (43 of 574; 7.5%). Red and white flowers as well as plants with small flowers were rarely visited (16 of 574; 2.8%) (Fig. 4). *Hieracium pilosella* and *Trifolium medium* (L., 1759, Fabaceae) were the most abundant flowering plant species at the time of our observations. However, *Trifolium medium* was clearly less used than *Hieracium pilosella*. *Lotus corniculatus* was often visited too, though it just started flowering during our field work.

Oviposition. In total, 62 egg ovipositions were observed. The eggs were placed exclusively on *Lotus corniculatus*. Only one egg per plant was laid although once two eggs were found on one plant. Fifty-three of the 62 eggs deposited (85%) were placed on the costa of the upper surface (Fig. 5), eight eggs (12.9%) on the inferior leaf surface, and one egg (1.6%) on the stalk. There were no flowers developed on any of the host plants at that time.

Most of the occupied plants were single-shooted (62.9%) or oligo-shooted young plants (20.9%). In six cases (9.7%), the eggs were laid on a side shoot of a young plant; in four cases (6.5%), the eggs were laid in a *Lotus corniculatus* stand (Fig. 6).

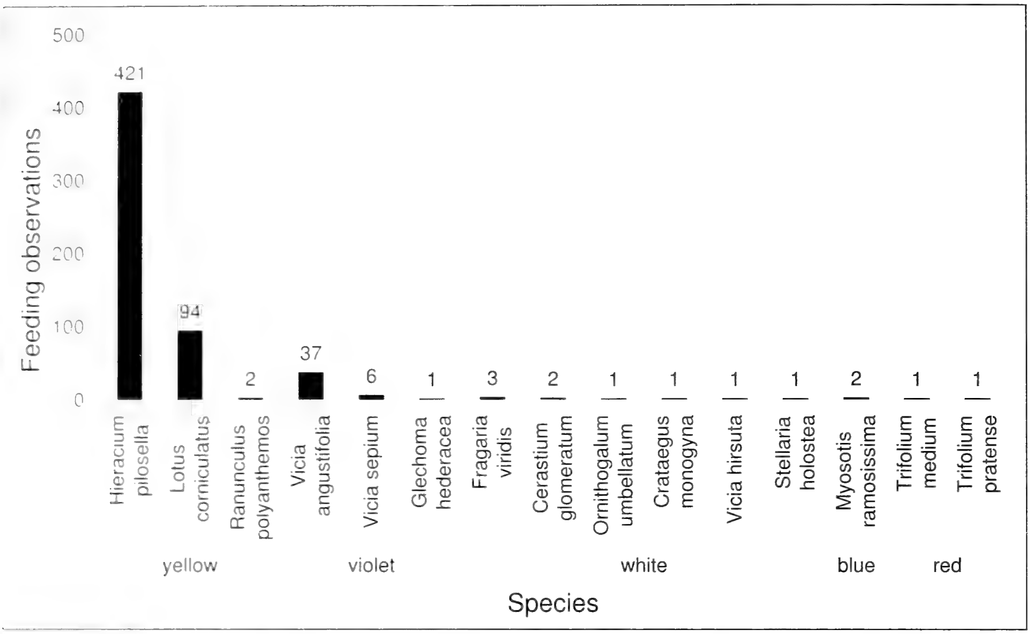


Fig. 4. Number of feeding observations during field work; n = 574.

Fig. 5. Shoots of Lotus corniculatus with eggs of *Erynnis tages* on the costa.

Most of the eggs (80.7%) were placed on small plants up to 9 cm height (Fig. 7). The highest number of eggs (45.2%) was found on plants that were 3 to 6 cm high. Egg placement on a plant that was more than 18 cm high was observed only once though extensive stands of *Lotus corniculatus* were the most frequent growth form (>80%)

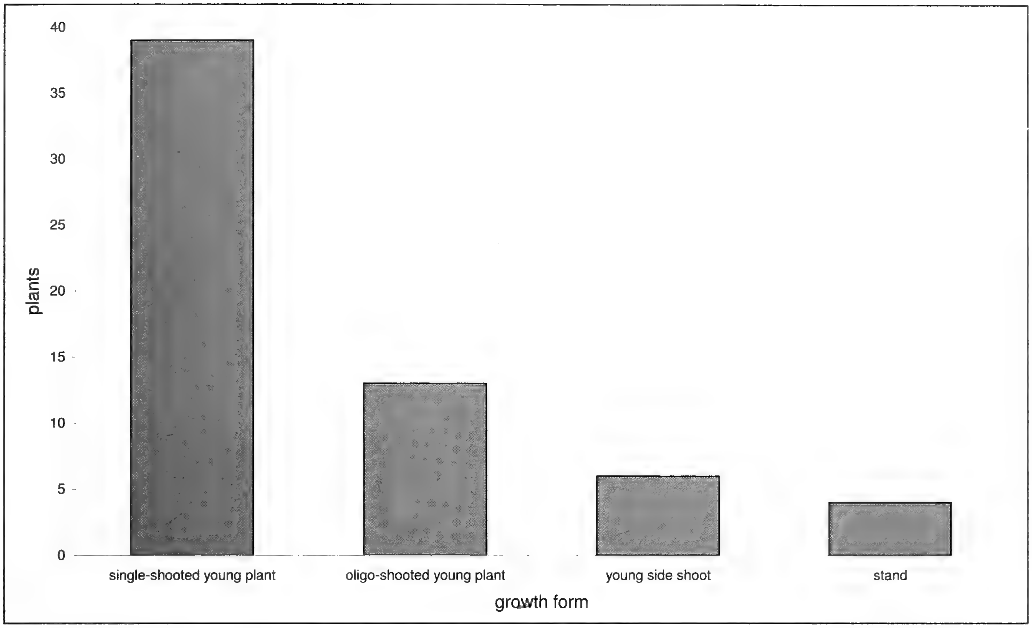


Fig. 6. Number of occupied *Lotus corniculatus* depending on growth form; n = 62.

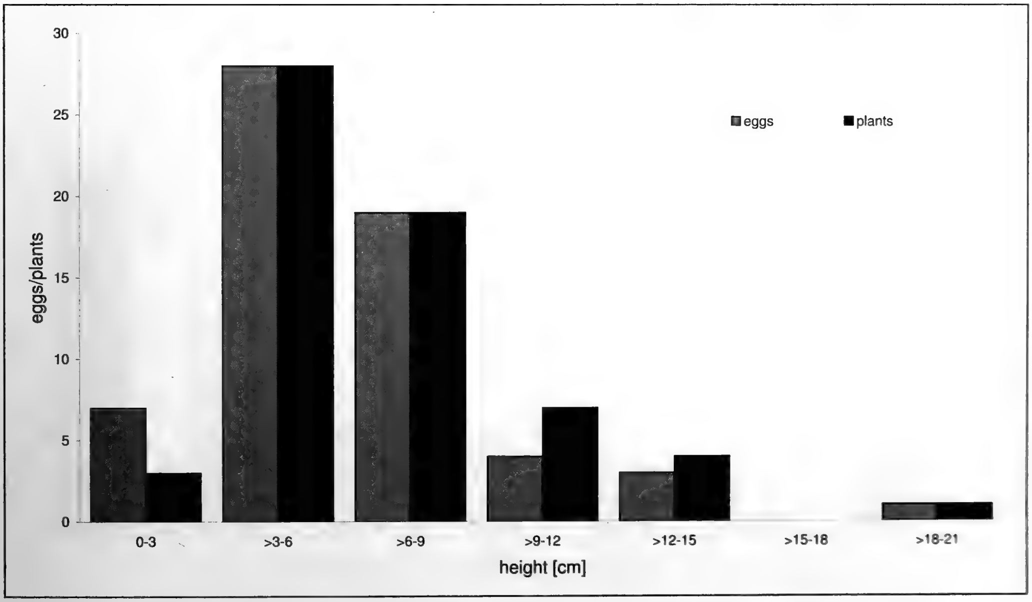


Fig. 7. Height [cm] of egg-laying of *Erynnis tages* and of occupied *Lotus corniculatus*; n = 62.

in the habitat. Most of the eggs laid (45.2%) were found 3 to 6 cm above ground. Above 6 cm, the number of eggs deposited decreased with an increase in the height of the plants. Egg depositions were only rarely observed at heights of more than 9 cm and less than 3 cm.

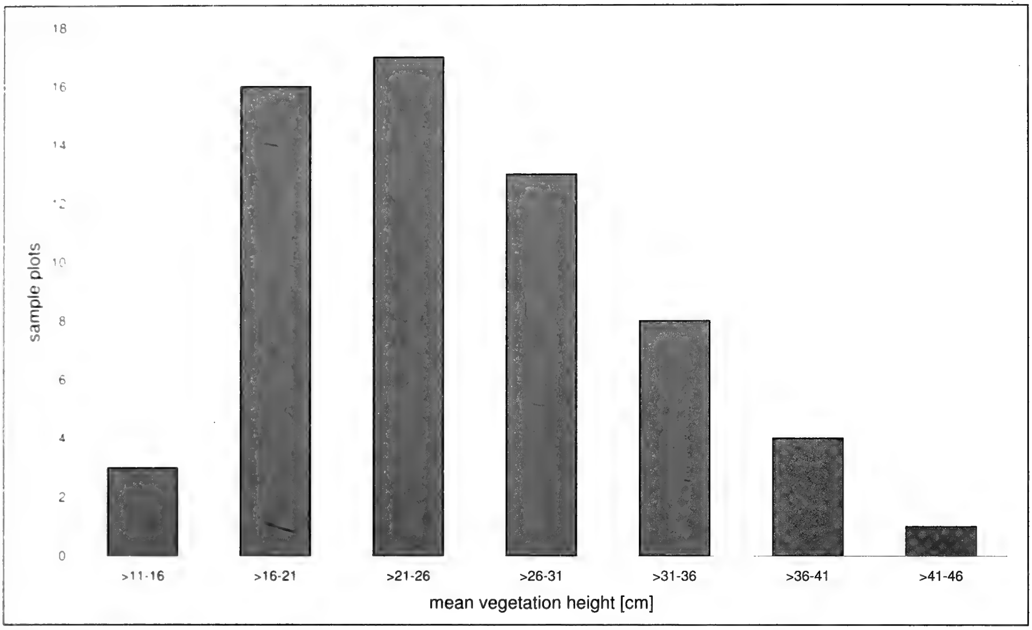


Fig. 8. Mean vegetation height [cm] one square meter around the occupied plants; n = 62.

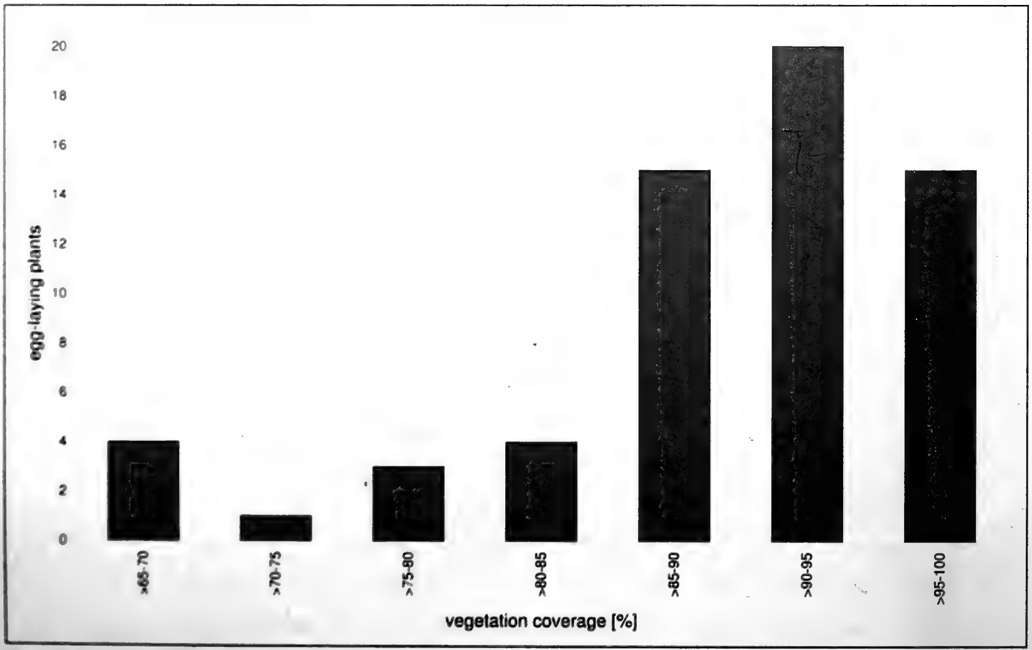


Fig. 9. Vegetation coverage [%] in the sample plots; n = 62.

Most of the occupied plants were located in plots with a mean vegetation height of >16 to 31 cm (74.2%). Below and above these values, ovipositions of *Erynnis tages* were observed in a wide spectrum of vegetation heights ranging between 11 and 42 cm

Tab. 1. Minimum (MIN), maximum (MAX), mean value (MV) and standard deviation (SD) for the examined parameters, n = 62.

	MIN	MAX	MV	SD
Plant height [cm]	2	20	6.8	± 3.3
Height of egg-laying [cm]	1.4	19.4	6.1	± 3.3
mean vegetation height [cm]	11.7	42	25.2	± 6.9
vegetation coverage [%]	70	100	91.7	± 8.1
mean litter layer height [cm]	0	6	1.4	± 1.4
Height of egg-laying in % of plant height	55.4	97.4	88.2	± 5.6

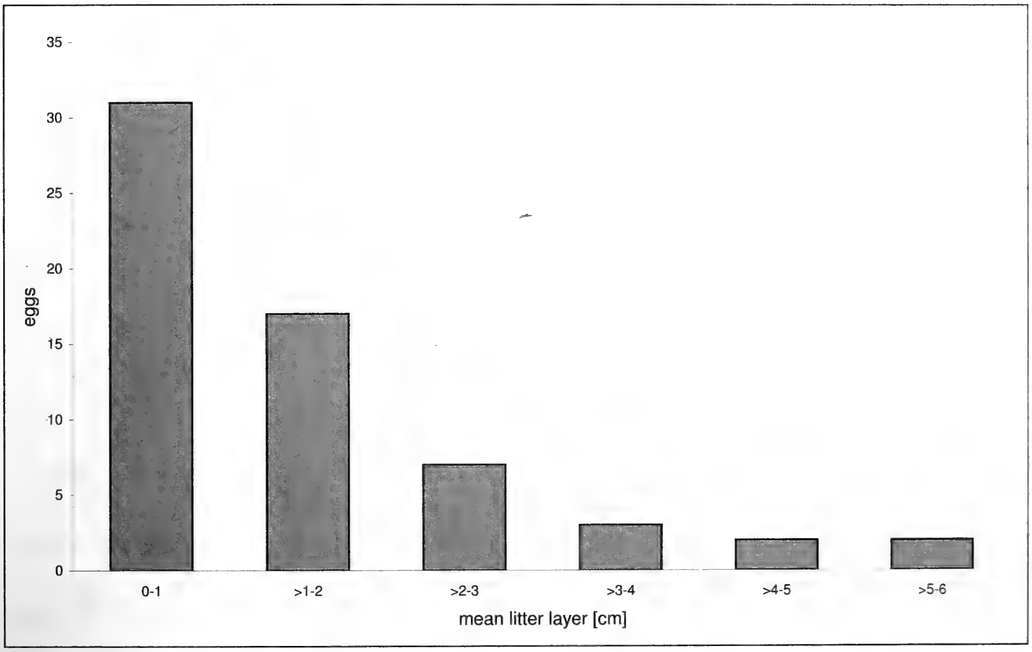


Fig. 10. Mean litter layer [cm] immediately under the occupied plant; n = 62.

(Fig. 8). The mean vegetation of all egg-laying sites was dominated by few grasses per square meter, resulting in a loose vegetation structure 5 cm above the ground.

The vegetation coverage in the examined plots was more than 65% in all areas. Most of the egg depositions (32.3%) were observed in sample plots with coverage between 90 and 95%. Overall, 80.7% of the eggs were placed in plots with more than 85% vegetation coverage (Fig. 9).

The litter layer was below 1.5 cm around a predominant number of the egg-occupied plants (71%). The number of egg depositions observed decreased with an increase in litter layer. The highest litter layer (6 cm) was observed only at one plant on which two eggs had been laid (Fig. 10).

For all parameters, the values for the minima and maxima show large deviations (Tab. 1).

Statistics. All recorded parameters were tested against the dependent variables "height of egg deposition" and "plant height" for the correlation analysis (Tab. 2). Significant linear correlations were found between plant height and mean litter layer, mean vegetation height and vegetation coverage as well as egg-laying height against plant height, mean litter layer, mean vegetation height, and vegetation coverage.

The height of egg deposition was positively correlated to plant height, but also with vegetation coverage, mean litter layer height, and mean vegetation height (Tab. 2). The height of the plant was also positively correlated with these four parameters (Tab. 2).

A positive correlation was also found between the height of egg deposition and the percentage of the used plant height. Most eggs were placed on the top 20% of the plant (Fig. 11).

Discussion

Visited flowers. The observation of flowers visited as nectar sources by *Erynnis tages* provided information on habitat requirements other than the larval food plant. Although *Lotus corniculatus* was the only plant observed for egg-laying, its importance as a nectar source for the adults was small, though it just started flowering during the time of our observations. The most abundant flowering plant species at that time were *Trifolium medium* and *Hieracium pilosella*. However, the most frequented flowering plant during this study was *Hieracium pilosella*. Whether this observation indicates a real preference for this plant species in general or just a reaction to the current flower offer (number in the study area during time of observation) cannot be answered at this time. Feeding observations on blue-violet flowers as well as red and white flowers may be assessed as an indication that *Erynnis tages* is able to use a wider spectrum of flowering plants. The affinity for Fabaceae, mentioned by Ebert & Rennwald (1993) could not be confirmed.

Egg-laying habitat. Our results show a clear preference for oviposition habitat in the investigated area. Because the observed *E. tages* females "showed" where they layed their eggs we can exclude that our results reflect our field search strategy or that alternative egg-laying structures were overlooked.

Plant height. The height of egg deposition was narrowly correlated with the height of the egg-laying plants. Small *Lotus corniculatus* plants were preferred as directly proven by our observations of the egg-laying females. The choice of small *Lotus corniculatus* plants for egg placement seems to point toward a narrow microclimatic preference because in the habitat such plants were only a minor resource. Extensive stands of *Lotus corniculatus* with plants more than 10 centimetres high dominated. The preference for small, isolated plants for oviposition contradicts the results of Gutiérrez et al. (1999) and Asher et al. (2001). They observed that females of *Erynnis tages* in Great Britain and Ireland chose large plants in hollows and sheltered situations as egg-laying sites. Fartmann (2004) found preferred egg-laying habitats of *Erynnis tages* in semi-dry and hot calcareous grasslands with short vegetation, where eggs were placed at a mean height of 7 cm and with a mean of 15% bare soil around the food

Tab. 2. Results of Spearman-rang-correlation (rs); n = 62; * = p < 0.05, ** = p < 0.01, *** = p < 0.001

	oviposition height	plant height
mean vegetation height [cm]	0.31*	0.30*
vegetation coverage [%]	0.28*	0.32*
litter layer height [%]	0.41**	0.38**
plant height [cm]	0.97**	-

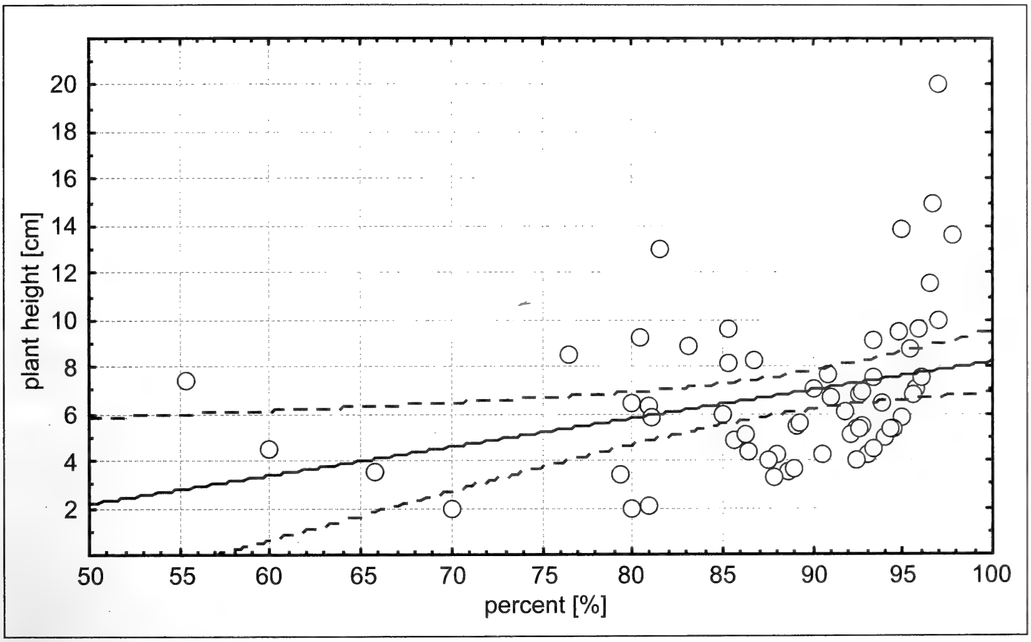


Fig. 11. Regression analysis of egg-laying height in percentage of the occupied plant versus plant height [cm]; r=0.32; p=0.01; y=-3.87 + 0.12*x.

plant. All studies indicate local accommodations on different habitats in order to find warm microclimatic conditions for oviposition. Therefore climatic differences between studied regions could be the reason for the use of varying habitat structures over the distribution range of *Erynnis tages*.

Mean vegetation height. A correlation between egg deposition and the mean vegetation height is shown. The eggs were mainly placed at sites with vegetation between 16 and 31 cm in height and dominated mostly by grasses. In all sample plots the vegetation structure was loose and dominated by single plants only. The advantage of these conditions is the combination of wind sheltering and good insolation of the eggs. Second, the females of *Erynnis tages* are able to fly low through the vegetation in search of oviposition plants (personal observation). No females have been observed flying in areas with high and dense vegetation.

Vegetation covering. Most eggs were deposited on plants surrounded by more than 80% vegetation coverage, mostly 100% coverage. Fartmann (2004) found most eggs in semi-dry grasslands on sites with varying percentages of bare ground around the food plant, preferably with 15% bare ground. In contrast, Gutiérrez et al. (1999) found that most eggs were laid "on large plants growing in hollows with intermediate cover of bare ground [...]".

This difference in habitat selection of the English population could be interpreted as local accommodation for the preferred warm microclimate as well. It is also known that bare ground is used by the imagos for warming up and for water intake on wet soil (Ebert & Rennwald 1993). It is likely that there must be open soil in the habitat in general to allow these activities.

Mean litter layer. The egg-laying height was positively correlated to the mean litter layer height surrounding the egg-laying plant. A microclimatic influence of the litter layer on the choice of egg-laying sites seems possible. As Fartmann & Hermann (2006) pointed out, species with eggs susceptible to drought depend on habitats with higher humidity, mostly in combination with warm microclimatic conditions. We have observed that most eggs of *E. tages* at our study site were placed on plants surrounded by a thin litter layer. Fartmann (2004) found the eggs of *E. tages* in semidry calcareous grasslands mostly on plants with no litter layer underneath.

Conclusions. For *Hesperia comma* (L., 1758) (Hesperiidae), Hermann and Steiner (1997) showed that occurrence, frequency, and distribution are strongly limited by quality and expansion of suitable oviposition habitats. This depended on different parameters such as microclimate, host plants, and quantity and quality of food (Fartmann & Hermann 2006). In this investigation a microclimatic preference could be assumed from the shown positive correlation of plant height and oviposition height with the parameters measured. Unfortunately we did not map all plants of *Lotus corniculatus* in the sample plots. Generally not more than 5 to 10 single shoots per sample plot were found. In contrast, all areas were *Lotus corniculatus* stood in extensive stands were not used for oviposition. We interpret the shown range of used vegetation densities by *Erynnis tages* as a microclimatic preference which leads to increasing use of higher plants with increasing vegetation density and height in the observed possible spectrum. With increasing litter layer, mean vegetation height, or vegetation coverage the height of *Lotus corniculatus* plants used for oviposition increased also. In contrast, the height of egg deposition was independent of the height of the used plant and with only a few exceptions the top 20% of the plant was used.

For *Erynnis tages*, the microclimatic conditions seem to be an important parameter. Gutiérrez et al. (1999) suggested that "selection for warm micro-sites for egg-laying can be the result of temperature requirements for the early stages [...]". Fartmann & Hermann (2006) assumed that exposition, slope, vegetation height, and vegetation coverage of the oviposition site as well as the height of egg deposition had a decisive influence on the microclimate and, consequently, on the chances of successful development from egg to imago.

In this study, the following oviposition requirements for *Erynnis tages* could be shown: (1) The egg-laying plants stood single; (2) The egg-laying plants were predominantly single stemmed, of stunted growth, and did not yet have developed flowers; (3) The eggs were placed on the leaf surface; (4) The eggs were laid on the top 20% of the plant; (5) The mean vegetation height ranged between 16 and 36 cm; and (6) The vegetation coverage was 85% or more. Occasional egg depositions on the inferior leaf surface or on the stalk may be connected to the plant's growth form. It may also depend on the way a female climbs along the host plant. Although extensive stands of *Lotus corniculatus* were most frequent at our study site, only small, single-stemmed young plants were chosen for oviposition by the observed females. The placement of just one egg per plant may be explained by a preference for young and small specimens of *Lotus corniculatus*; there were not enough food resources for more than one larva on one plant. Plants bearing eggs of their own species are often avoided in order to prevent competition between larvae (Fartmann & Hermann 2006).

References

Asher, J., M. Warren, R. Fox, P. Harding, G. Jeffcoate & S. Jeffcoate 2001. The Millennium Atlas of Butterflies in Britain and Ireland. – Oxford University Press, Oxford. 433 pp.

Braun-Blanquet, J. 1964 (3rd edn.). Pflanzensoziologie. – Springer, Wien-New York. 865 pp.

Ebert, G. & E. Rennwald (eds) 1993. Die Schmetterlinge Baden-Württembergs; Band 2, Tagfalter II. – Ulmer, Stuttgart. 535 pp.

Fartmann, T. 2004. Die Schmetterlingsgemeinschaften der Halbtrockenrasen-Komplexe des Diemeltales. – Abhandlungen aus dem Westfälischen Museum für Naturkunde **66**: 1–256.

Fartmann, T. & G. Hermann 2006. Larvalökologie von Tagfaltern und Widderchen in Mitteleuropa – von den Anfängen bis heute. Pp. 11–57 – *In*: Fartmann, T. & G. Hermann (Eds), Larvalökologie von Tagfaltern und Widderchen in Mitteleuropa. – Abhandlungen aus dem Westfälischen Museum für Naturkunde **68**. 361 pp.

Gutiérrez, D., C. D. Thomas & J. L. León-Cortés 1999. Dispersal, distribution, patch network and metapopulation dynamics of the dingy skipper butterfly (*Erynnis tages*). Oecologia **121**: 506–517.

Hermann, G. & R. Steiner 1997. Eiablage- und Larvalhabitat des Komma-Dickkopffalters (*Hesperia comma* Linné, 1758) in Baden-Württemberg (Lepidoptera, Hesperiidae). Carolinea **55**: 35–42.

Kolligs, D. 1998. Die Großschmetterlinge Schleswig-Holsteins – Rote Liste. – Landesamt für Natur und Umwelt des Landes Schleswig-Holstein. 68 pp.

Kolligs, D. 2003 (2nd edn). Schmetterlinge Schleswig-Holsteins: Atlas der Tagfalter, Dickkopffalter und Widderchen: Bilanz und Analyse der Gefährdungssituation. – Wachholtz, Neumünster. 218 pp.

Stolze, M. 2005. Status over Danmarks dagsommerfugle 2005. – Internet publication: http://www.dof.dk/pdf/nyhede.

Bernard Skinner (Illustrations by David Wilson) 2009. Colour identification guide to moths of the British Isles (Macrolepidoptera), 3rd revised and updated edition. – Apollo Books, Stenstrup. – 325 pp. incl. 51 colour pls. – Hardcover, ISBN 978-87-88757-90-3. Price 69 € (See www.apollobooks.com).

The scope of this beautifully prepared book is all macro moths, as well as the Hepialidae, Cossidae, Zygaenidae, Limacodidae, and Sesiidae of the British Isles (including all of Ireland). It treats more than 750 species, but the exact number is unspecified. Its purpose is to provide photos of the moths to enable their identification by wing pattern. In variable species up to six or more specimens are shown on the plates.

The second edition of the work, published in 1998, has been expanded here to treat a number of additional species shown on three extra plates from the original 42, which are simply presented anew, but which are better in quality than in previous editions (P. Skou, pers. comm.; I didn't have access to previous editions). In addition, there are six new plates with 2× natural size exquisite photos of the right pair of wings of species that are more difficult to identify, with the species names mentioned directly on the plates. In some cases the upper- and undersides of the wings are presented. There is no doubt that these new plates will be found very useful, and some of the species of *Eupithecia* would have benefited from being presented on these plates as well. However, in general I found the plates all a bit dark. The plate legends give the English and scientific names with the page number on which the species treatment starts.

The text is devoted almost entirely to the species treatments, although most families are given a short introduction as well. A preface explains in one page the reasoning behind the making up of this new edition. A page of acknowledgements, misspelled in heading without final 's' and half a page of introduction follow. Among others, author B. Skinner thanked Roger Tory Peterson for his permission to use his method of pointers in some of 57 sets of black and white figures scattered throughout the text and designed to illustrate diagnostic characters. The introduction explains where the common and scientific names of plants and insects come from, as well as those used for counties. A glossary and abbreviations page precedes the species descriptions. It is supplemented by a useful drawing with labels to the diverse wing pattern elements and main body parts.

Each species description is headed by the common name, followed by the scientific name, and a plate and figure number. The descriptions per se start with or without chapters on variation and/or similar species, depending on the need for this information. The following chapter, titled Imago, gives wingspan, resident status, flying habit and phenology, habitat, distribution, and abundance. A Larva chapter then provides information on time of occurence and host-plant(s) of the caterpillar. Sometimes a chapter on the pupa is provided as well.

The colour plates immediately follow the species description and then, a page with heading 'Further information' gives the names of the species protected by Law, a few useful references, and the names and addresses of four local entomological societies. This is followed by a list of the host-plants with their scientific names, an index of moth scientific names, and one for moth English names. The latter indices are easy to use as only the page numbers, in normal type, and plate number(s) in bold type are provided.

Leafing through the species accounts one can tell why the moth fauna of the British Isles is one of the best known, if not **the** best known in the world. For example, I was impressed to find the exact records known to date of several immigrant species. In my opinion, this book's purpose is achieved nicely, and it will undoubtedly contribute to making this fauna even better known.

BERNARD LANDRY

Microhabitat requirements of caterpillars of the critically endangered butterfly *Chazara briseis* (L.) (Nymphalidae, Satyrinae) in the Czech Republic

TOMAS KADLEC[1], PAVEL VRBA[2] & MARTIN KONVICKA[2,3]

[1] Department of Ecology, Faculty of Science, Charles University, Vinicna 7, 128 44 Prague, Czech Republic; e-mail: lepidopter@seznam.cz (corresponding author)
[2] Department of Zoology, School of Biological Sciences, University of Southern Bohemia, Branisovska 31, 370 05, Ceske Budejovice, Czech Republic; e-mail: vrba_pavel@centrum.cz
[3] Institute of Entomology, Czech Academy of Sciences, Branisovska 31, 370 05 Ceske Budejovice, Czech Republic; e-mail: konva@entu.cas.cz

Abstract. We report the larval microhabitat preferences of the critically endangered Hermit butterfly, *Chazara briseis* (L.) (Nymphalidae, Satyrinae), from a population inhabiting steep basaltic hills of the Ceske Stredohori highlands, Czech Republic. Based on field records of 61 pre-pupation larvae, we argue that they require dry, south to south-west exposed slopes containing short tufts of their fescue host-plants (*Festuca ovina* L. agg.) growing on exposed bedrock. These conditions have been maintained by traditional sheep grazing, recently supplemented by trampling along tourist paths. These preferences are practically identical to those found in an earlier study near Halle an der Saale, Germany, situated 180 km to the northeast. Despite the larval preference for short-sward vegetation, *C. briseis* also requires taller-sward and even shrubby patches providing nectar and shelter for adults. Heterogeneity of conditions is also necessary for several co-occurring endangered insects, including Lepidoptera. Efficient conservation of *C. briseis* should be planned and practised over the whole area of occurrence of the population.

Introduction

The Hermit, *Chazara briseis* (Linnaeus, 1764) (Nymphalidae, Satyrinae) is increasingly threatened throughout the European part of its range. Its global distribution includes the Mediterranean region, Europe up to southern Scandinavia, southern Russia, Asia Minor, Central Asia, and Northern China. This specialist of xeric grasslands was once widely distributed in all warmer regions of Central Europe. It underwent a severe decline during last decades due to habitat loss caused mainly by abandonment of grazing and by subsequent successional overgrowth, locally hastened by intentional afforestation of its sites (e.g. Dolek & Geyer 1997; Reinhardt et al. 2007). The speed of the decline is illustrated by the situation in the Czech capital Prague, where the butterfly was so common in the 1950s that it was nicknamed "the Prague butterfly", but it completely disappeared after the 1980s (Kadlec et al. 2008). In the whole country, the species occurred in 60 atlas grid cells (10 × 11 km) prior to the 1950s, but occurs in just three cells presently (Benes et al. 2002; Czech butterfly recording scheme). Similarly rapid losses are under way in Austria, Germany, Hungary, Poland, Romania, and Slovenia (Ebert & Rennwald 1991; Buszko 1993; Van Swaay & Warren 1999; Cremene et al. 2005; R. Verovnik pers. comm.).

In 2006 we made an autecology research of the last large (meta)population in the Czech Republic, in the Ceske Stredohori highlands. The population appeared prospering, containing over 1000 adults of each sex in ten separate but mutually interconnected colonies, and exhibiting a high within-population genetic diversity. Less optimistically,

Nota lepidopterologica, 15.5.2009, ISSN 0342-7536

our findings were remarkably similar to those found a decade ago in Germany, Halle an der Saale region, 180 km to the NW from our study area, within a volcanic chain forming a continuation of the Ceske Stredohori highlands. This German (meta)population appeared as abundant, structured, and genetically diverse (Seufert & Grosser 1996), but despite these signs of a healthy status, it has become nearly extinct during just a decade (M. Dolek, pers. comm.). We also discovered, in the Czech population, that inseminated females required a strikingly long period of about three weeks to complete egg maturation. This pattern, characteristic for several genera of large Satyrinae (Garcia-Barros 2000), resulted in only 25–50 per cent of adult females living long enough to lay any eggs during their lifetime (unpubl. data). This demographic load decreases the effective population size to a half, or even a quarter, of the census population. Viable populations of *C. briseis* thus must contain twice to four times as many individuals than populations of "normal" butterflies. Because large populations require large areas of habitat, restoration of suitable habitat conditions over large pieces of land appears as the only chance to preserve *C. briseis* in Central Europe.

In this study, we focus on larval habitats of the Ceske Stredohori population. We (i) describe the larval requirements of the Ceske Stredohori populations; (ii) compare them with the situation at geographically close sites in Germany; and (iii) discuss the conservation implications of the larval requirements.

Material and methods

Study system. The studied population inhabits steppic grasslands on ten basaltic hills at the southwestern edge of the Ceske Stredohori Highlands, NW Czech Republic (–). The grasslands are believed to have been present there for the entire Holocene owing to grazing pressure combined with a highly continental climate in rain shadows of the Krusne Mts (Lozek 2000). They were traditionally used as sheep pastures, whereas the intermingling landscape consists of arable fields and orchards. The grazing management has been declining gradually from the early 20th century onwards, some of the hills were intentionally afforested, and the land use changes accelerated in the 1960s (intensification of agriculture, further decline of sheep grazing), and again in the 1990s (closure of remaining commercial sheep farms).

The hills represent an important refuge for the steppic flora and fauna in Central Europe. Besides of *C. briseis*, they host the last Czech populations of several species of Lepidoptera, such as the lycaenid butterflies *Polyommatus damon* (Denis et Schiffermueller, 1775) and *Pseudophilotes vicrama* (Moore, 1865), the arctiid moth *Watsonarctia casta* (Esper, 1785), and the noctuid *Sideridis lampra* (Schawerda, 1913). Notable Orthoptera include *Euchorthippus pulvinatus* (Fischer-Waldheim, 1846), *Oedipoda germanica* (Latreille, 1804), *Stenobothrus eurasius* (Zubowsky, 1898), and *Modicogryllus frontalis* (Fieber, 1844). The area also harbours one of the last viable populations of European souslik, *Spermophilus citellus* (Linnaeus, 1766), in Czechia (Cepáková & Hulová 2002). Parts of the hills are protected as reserves, and their managers, approximately from 2000 onwards, are battling the natural succession by small-scale sheep grazing and scrub clearance. Another important activity is a tolerated use of one of the hills for aeronautic sports, such as hang gliding and paragliding.

Chazara briseis adults appear in mid-July, but the females start laying eggs as late as late August (unpubl. data). They do so singly, utilising shorter-sward patches, maintained by grazing or trampling. The host plants are fescue grasses (*Festuca ovina* agg., *F. pallens* H.) and *Sesleria albicans* Sch. (Ebert & Rennwald 1991) (Poaceae). The larvae emerge at the end of September, overwinter in the first instar, and pupate in early summer.

Data and analysis. We searched for caterpillars at Rana hill, a colony that hosted almost 40% of the total adult numbers (870 out of 2300) in 2006, for a total of three nights in 2007 (May 30, June 1 and 3, 2007). We always begun at sunset and used torch light to search short-sward patches, where we observed the majority (26 out of 30) of oviposition events during the mark-recapture study in September of the previous year. These places were either grazed by sheep, or occasionally trampled owing to proximity of walking paths. For each caterpillar found, we recorded the closest hour, temperature, cloudiness, wind, behaviour (feeding, resting, crawling), and its body length. We then delimited a circle with a 0.25 m^2 surface around the larva and ortho-photographed it from a height of 1.5 m. These photographs were subsequently used to quantify the proportional amount of open soil and rocks, host-plants and other vegetation, using the program DIVA-GIS version 5.2.0.2 (www.diva-gis.org). For each positive record we also measured the height of the vegetation, inclination, and geographical aspect. We established the minimum distance to the nearest shrub (up to 5 meters), habitat type (distinguishing short-sward steppe – maximum height of vegetation < 50 cm and long-sward steppe – height of vegetation > 50 cm), and habitat structure (open – grasslands without shrubs, shrubby – grasslands with sparse growth of shrubs, forest steppe – mixture of grassland, scrub and occasional trees). The data were compared with similar data from a German population near Halle an der Saale (Seufert and Grosser 1996), using χ^2 tests.

Results

During the three-night search, we located a total of 61 *C. briseis* larvae at 55 separate plots (6 plots hosted two larvae) (Fig. 1). The length of the caterpillars was 18–38 mm (30.7±3.7SD), corresponding to the last two larval instars.

The prevailing weather was mild, with half-overcast sky and weak gusts of wind. The temperature was around 10 C, dropping to 4 C before sunrise. The first caterpillars were observed around 10 pm, the last were still active at 3 am. Most of the interim time ($n = 49$), they fed on fescue grasses from the *Festuca ovina* group, whereas only twelve larvae crawled or rested on barren substrate ($n = 2$) or on herbaceous material ($n = 10$). The fescue tufts used were narrow, with a surface of 120–240 cm^2; only few larvae fed on narrower or wider ones.

All larvae were found on slopes exposed mainly to the S or SW (Tab. 1). The habitat was short-sward steppe, locally overgrown by shrubs (the mean distance from larvae

Tab. 1. Comparison of conditions of larval sites at two nearby regions hosting populations of *Chazara briseis*. In all cases except for n (sample size), means ± *SD*, Chi-sq values of tests, and *P* values are presented. Data for the German population are from Seufert & Grosser (1996).

Population	n	Inclination (°)	Exposition (°)	Barren ground (%)	Turf height (cm)
Ceske Stredohori (Cz)	55	17.5 ± 5.8	180.8 ± 31.4	31.7 ± 13.3	22.8 ± 8
Halle an der Saale (D)	26	20.8 ± 6.6	172.8 ± 31.6	23.6 ± 20.1	14.3 ± 6.3
Chi-sq values		0.1424	0.0905	0.5964	0.9867
P		>0.1	>0.1	>0.1	>0.1

to the edges of the nearest shrub: 120±70 cm). All occupied plots were either grazed by sheep a year before ($n = 40$) or trampled by visitors ($n = 15$). The turf was short and sparse (Tab. 1, Fig. 2).

In the German population (Seufert & Grosser 1996), caterpillars were found in remarkably similar conditions. Their habitats were also restricted to volcanic hills, and the conditions at occupied plots were practically identical to the conditions within the Czech population (Tab. 1). There were no differences between conditions in the Czech and the German population (all χ^2 tests were non-significant at $P > 0.1$).

Discussion

We located a relatively high number of caterpillars during the three-night searches. This was likely because we restricted the sampling to sections of the Rana hill with short steppic vegetation, where a year before we actually observed ovipositing females, i.e. the mothers of the investigated larvae. The area with suitable conditions is rather restricted on the hill, covering no more than 30 ha, whereas the remaining 140 ha of the hillsides is covered by tall-sward formations dominated by *Stipa* spp., completely unsuitable for the butterfly.

The caterpillars used either grazed or trampled micro-sites. Both grazing and trampling favour the low growing tussocky host plants (*Festuca ovina* agg., *Sesleria albicans*) over tall-bladed ones (e.g., *Stipa* spp.) (cf. Hill et al. 1992) thus increasing host plant supply. They also maintain bare bedrock (Fig. 2), which, here and in other studies (Dolek & Geyer 1997; Königsdorfer 1997; Leopold 2001), appears to maintain a warm and dry microclimate suitable for the *C. briseis* development (examples from other butterfly species, e.g., Thomas 1995; Fartmann 2006; Maes et al. 2006). The decline of the heterogeneous, non-intensive grazing, once carried out by most of the village households across Central Europe, is widely recognised as the main reason for the *C. briseis* decline. Once the grazing is terminated, the conditions change dramatically from short, tussocky vegetation to taller-sward. Grass feeding by sheep, on the other hand, probably does not harm the caterpillars owing to their nocturnal activity and the ability to wander among host-plants, e.g., if entire the tussock is consumed.

The hills were left ungrazed for almost a decade during the 1990s, after the last commercial sheep farms in the area left and before local conservationists established a conservation grazing regime. During that time, the only active disturbance was trampling by hikers

Fig. 1. A caterpillar of the Hermit (*Chazara briseis*). Rana Hill, Ceske Stredohori, Czech Republic, May 30, 2007.

and fans of aeronautic sports. For some time, it was feared that these activities may harm the grassland vegetation. This view is changing rapidly as it is becoming clear that limited trampling is beneficial for *C. briseis* and other species profiting from the presence of patches of barren ground.

The short-sward patches with barren bedrock – i.e., the larval habitat – represent just one of several resources required by *C. briseis*. Further resources include nectar supply, critical for this long-lived species (Garcia-Barros 2000), and shelter. We observed that if the ground cover was appropriate for larvae, sparse solitary shrubs nearby did not affect the occurrence of caterpillars, and the shrubs instead provided shelter for ovipositing females (unpublished data). It follows that managing localities for *C. briseis* requires maintenance of heterogeneous conditions via applying such measures as fencing to temporarily exclude grazing animals.

Heterogeneity of conditions is also necessary for other co-occurring and endangered species. While some such species require the short sward utilised by *C. briseis* larvae (e.g., the butterfly *P. vicrama*, the mammal *S. citellus*), others prefer taller herbaceous vegetation. Perhaps the most dramatic case is represented by *Polyommatus damon*, an endangered species occurring in the Czech Republic in just four populations. The butterfly is absolutely intolerant to sheep grazing (e.g., Kudrna 1998; Dolek & Geyer 2002), in striking contrast to *C. briseis*. While past landscapes consisted of fine-grained patchworks allowing sensitive insects to track temporarily suitable sites (e.g., Kruess & Tscharntke 2002; Saarinen & Jantunen 2005), modern landscapes consist of large and homogeneously managed tracks of land, and conservation management strives to pack entire past habitat diversity into limited space of reserves (Morris 2000; Bourn & Thomas 2002; Wenzel et al. 2006).

The striking similarity between the Czech Ceske Stredohori and the German Halle an der Saale populations, and the pessimistic fate of the latter, allow some speculation on the Czech population's future. The German population has been declining rapidly despite its seemingly good condition a decade ago (M. Dolek, pers. comm.). The underlying reason seems to be the requirement for large numbers of individuals, plus the complex habitat requirements of the butterfly: short-sward larval habitat, taller-sward nectar-rich sites, and sheltering shrub. To prevent a decline of the Czech population, it is necessary to expand the current conservation grazing to a considerably larger area, while maintaining sufficient extents of taller-sward grassland and scrub. This requires comprehensive management of the entire area, including restoration of more favourable conditions in long-abandoned orchards at the piedmonts of the hills, now covered by impenetrable scrub. This will incur considerable cost, but the positive news is that there

Fig. 2. Suitable microhabitat structure occupied by *C. briseis* larvae. Short-sward grassland with high proportion of exposed bedrock.

is enough space for a generous restoration project, as much of the land is currently unused. Conserving the system is also easily reconcilable with a regulated recreation use of the hills by hikers and aeronautic sports fans. A species action plan, now under preparation, should secure coordination of all these activities.

Acknowledgements

We thank V. Kadlec for helping in the field, T. Fartmann for providing some less accessible literature, and M. Dolek, J. Settele, J. Kulfan, and R. Verovnik for discussing the fate of *C. briseis* populations in Germany, Slovakia, and Slovenia. The study was supported by the Czech Department of Environment (VaV 620/1/03), Department of Education (6007665801, LC06073), doctoral grant (206/08/H049), and the Grant Agency of the Czech Republic (206/05/HO12).

References

Wenes, J., M. Konvicka, J. Dvorak, Z. Fric, Z. Havelda, A. Pavlicko, V. Vrabec & Z. Weidenhoffer (eds.) 2002. Butterflies of the Czech Republic: Distribution and conservation I., II. – SOM, Prague, 857 pp.

Bourn, N. A. D. & J. A. Thomas 2002. The challenge of conserving grassland insects at the margins of their range in Europe. – Biological Conservation **104**: 285–292.

Fig. 3. Shrubby short-sward steppic grasslands in the Ceske Stredohori hills host a number of endangered insects besides C. *briseis*. The habitats are under serious threat due to ongoing successional processes.

Buszko, J. 1993. Atlas motyli Polski. I. Motyle dzienne (Rhopalocera). – Grupa IMAGE, Warszawa. 269 pp.

Cepáková, E. & Š. Hulová 2002. Current distribution of the European souslik (*Spermophilus citellus*) in the Czech Republic. – Lynx **33**: 89–103.

Cremene, C., G. Groza, L. Rakosy, A. Schileyko, A. Baur, A. Erhardt & B. Baur 2005. Alterations of steppe-like grasslands in Eastern Europe: a threat to regional biodiversity hotspots. – Conservation Biology **19:** 1606–1618.

Dolek, M. & A. Geyer 1997. Influence of management on butterflies of rare grassland ecosystems in Germany. – Journal of Insect Conservation **1**: 125–130.

Dolek, M. & A. Geyer 2002. Conserving biodiversity on calcareous grasslands in the Franconian Jura by grazing: a comprehensive approach. – Biological Conservation **104**: 351–360.

Ebert, G. & E. Rennwald 1991. Die Schmetterlinge Baden-Württembergs. Vol 2: Tagfalter II. – Ulmer, Stuttgart. 535 pp.

Fartmann, T. 2006. Welche Rolle spielen Störungen für Tagfalter und Widderchen? Pp. 259–270. – *In*: T. Fartmann & G. Hermann (eds.), Larvalökologie von Tagfalter und Widderchen in Mitteleuropa. Wesfälisches Museum für Naturkunde 68 (3/4), Münster.

Garcia-Barros, E. 2000. Comparative data on the adult biology, ecology and behaviour of species belonging to the genera *Hipparchia*, *Chazara* and *Kanetisa* in central Spain (Nymphalidae: Satyrinae). – Nota lepidopterologica **23**: 119–140.

Hill, M. O., D. F. Evans & S. A. Bell 1992. Long-term effects of excluding sheep from hill pastures in North Wales. – Journal of Ecology **80**: 1–13.

Kadlec, T, J. Benes, V. Jarosik & M. Konvicka 2008. Revisiting urban refuges: changes of butterfly and burnet fauna in Prague reserves over three decades. – Landscape and Urban Planning **85**: 1–11.

Köningsdorfer, M. 1997. Die Berghexe (*Chazara briseis* L., Satyridae) in Schwaben und angrenzenden Gebieten. – Berichte des naturwissenschaftlichen Vereins für Schwaben e. V. **100**: 69–87.

Kruess, A. & T. Tscharntke 2002. Grazing intensity and the diversity of grasshoppers, butterflies, and trap-nesting bees and wasps. – Conservation Biology **16**: 1570–1580.

Kudrna, O. 1998. Die Tagfalterfauna der Rhön. – Oedippus **15**: 1–158.

Leopold, P. 2001. Schmetterlingszönosen ausgewählter Kalk-Magerrasen im Saale-Unstrut-Gebiet (Sachsen-Anhalt) unter besonderer Berücksichtigung der Habitate des Segelfalters und der Berghexe. – Unpublished Diploma thesis, Westfälische Wilhelms-Universität Münster, Inst. Landschaftsökologie.

Lozek, V. 2000. Problematika krajinné historie Českého středohoří. [Problems of landscape history of the Ceske stredohori Mts.] – Ochrana přírody **55**: 18–24.

Maes, D., A. Ghesquiere, M. Logie & D. Bonte 2006. Habitat use and mobility of two threatened coastal dune insects: implications for conservation. – Journal of Insect Conservation **10**: 105–115.

Morris, M. G. 2000. The effects of structure and its dynamics on the ecology and conservation of arthropods in British grasslands. – Biological Conservation **95**: 129–142.

Reinhardt, R., Sbieschne, H., Settele, J., Fischer, U. & G. Fiedler 2007. Tagfalter von Sachsen. Pp. 537–541 – *In*: Klausnitzer, B. & R. Reinhardt (eds.), Beitrage zur Insektenfauna Sachsen Band 6. Entomologische Nachrichten und Berichte, Dresden.

Saarinen, K. & J. Jantunen 2005. Grassland butterfly fauna under traditional animal husbandry: contrasts in diversity in mown meadows and grazed pastures. – Biodiversity and Conservation **14**: 3201–3213.

Seufert, W. & N. Grosser 1996. A population ecological study of *Chazara briseis* (Lepidoptera, Satyrinae). Pp. 268–274. – *In:* Settele, J., C. R. Margules, P. Poschlod & K. Henle (eds.), Species survival in fragmented landscapes. Kluwer Academic, Dordrecht.

Thomas, J. A. 1995. The conservation of declining butterfly populations in Britain and Europe: priorities, problems and successes. – Biological Journal of the Linnean Society **56**: 73–93.

Van Swaay, C. A. M. & M. S. Warren 1999. Red Data book of European butterflies (Rhopalocera). – Nature and Environment, No. 99. Council of Europe Publishing, Strasbourg.

Wenzel, M., T. Schmitt, M. Weitzel & A. Seitz 2006. The severe decline of butterflies on western German calcareous grasslands during the last 30 years: a conservation problem. – Biological Conservation **128**: 542–552.

On the identity of *Psodos perlinii* Turati, 1914 (Geometridae: Ennominae)

SVEN ERLACHER [1] & CLAUDIA JUNGHANS [2]

[1] Museum für Naturkunde, Moritzstraße 20, 09111 Chemnitz, Germany;
e-mail: erlacher@naturkunde-chemnitz.de

[2] Universität Leipzig, Institut für Biologie II, AG Molekulare Evolution & Systematik der Tiere

Abstract. One of the type specimens of *Psodos perlinii* Turati, 1914, which was believed destroyed was surprisingly found in the Wehrli collection at the Museum Alexander Koenig in Bonn. This specimen is here designated as a lectotype and is figured for the first time. A study of Turati's original description as well as an examination of the genitalia of the specimens collected in the Adamello region showed that *"Psodos perlinii"* is conspecific with the species *Psodos bentelii* Rätzer, 1890. Because of the geographical isolation of the Adamello population and its phenotypic characteristics, we propose giving *P. perlinii* the status of a subspecies of *P. bentelii*: *Psodos bentelii perlinii* Turati, 1914 stat. n.

Zusammenfassung. Eines der zerstört geglaubten Typus-Exemplare von *Psodos perlinii* Turati, 1914 wurde überraschend in der Kollektion Wehrli am Museum Alexander Koenig Bonn gefunden. Das Exemplar wird hier als Lectotypus designiert und erstmals abgebildet. Das Studium der Urbeschreibung Turatis sowie genitalmorphologische Untersuchungen der am Adamello gesammelten Tiere ergaben, dass das Taxon *„P. perlinii"* mit *Psodos bentelii* Rätzer, 1890 konspezifisch ist. Aufgrund der geografischen Isolation und phänotypischer Charakteristika wird für *P. perlinii* ein Unterartstatus zu *P. bentelii* vorgeschlagen: *Psodos bentelii perlinii* Turati, 1914 stat. n.

Introduction

During our work on the taxonomy and distribution of the high mountain Geometrid moths genus *Psodos* Treitschke, 1825 we came across the often mentioned and mysterious taxon '*Psodos perlinii* Turati, 1914', whose identity has remained dubious despite various attempts of clarification (Wehrli 1919, 1921; Forster & Wohlfahrt 1980; Burmann & Tarmann 1983).

At the beginning of the last century, Conte Emilio Turati described a new Geometrid moth species based on two males collected by C. Krüger in the higher region of the Adamello in Northern Italy, which he named *Psodos perlinii* (Turati 1914). After that, E. Wehrli acquired a third specimen from the type locality, also collected by C. Krüger, which he figured in his first work on the genus *Psodos* "with doubts" as *P. perlinii* (Wehrli 1919). After examination of the genitalia, Wehrli (1921) held that illustrated specimen to be a taxon "close to" *Psodos canaliculata* (Hochenwarth, 1785) (Wehrli 1921). Consequently, Schwingenschuss (1923) listed *P. perlinii* as a separate species within the *P. canaliculata* group. Finally, however, Wehrli stated that the third specimen in question had "turned out a true *trepidaria*", i. e. *P. canaliculata* (Wehrli 1954).

Eventually Wehrli received from Turati one of the two type specimens ("Kotype") for his comprehensive work on the palaearctic Geometridae. However, he was only permitted to examine the specimen without dissection (Wehrli 1954). On the bases of an external examination of the male genitalia of that type specimen, Wehrli found a close relation of *P. perlinii* to *Psodos spitzi* Rebel, 1905 ("soweit dies durch die Trockenuntersuchung festgestellt werden konnte" [as far as this was possible to determine through a dry examination], Wehrli 1954: 631) and gave a comparison of both species. Accordingly, Wolfsberger (1966) treated *P. perlinii* as a separate species within the subgenus *Triglavia* Povolny & Moucha, 1955, to which *P. spitzi* belongs. However, this was not yet the end of the confusion on *P. perlinii*.

Forster & Wohlfahrt (1981) contended in their well-known standard work on Central European Geometridae that *P. perlinii* is possibly a subspecies of *Psodos coracina* (Esper, 1805). Burmann & Tarmann (1983) came to the same conclusion after evaluation of material collected (by K. Burmann & J. Wolfsberger) in the Adamello Mountains and after comparison with the original description by Turati and with the results of comprehensive examinations of the genitalia of other species. Nevertheless, the authors did not avoid drawing attention to the problems which occurred with regard to the destruction of Turati's types in the collection of F. Hartig (Museo Regionale di Scienze Naturali di Torino). Thus, the attempts by Burmann & Tarmann (1983) to clarify the identity of *P. perlinii* remained unsatisfactory. Whereas Müller (1996), following Raineri & Zangheri (1995), still treated *P. perlinii* in his check-list of the Geometrid moths of Europe as a separate species, *P. perlinii* is listed in Scoble (1999), in agreement with Burmann & Tarmann (1983), as a subspecies of *P. coracina*.

Since 1954, the comprehensive Wehrli collection of *Psodos* has been deposited in the Museum Alexander Koenig in Bonn. At the beginning of the 1980s, this *Psodos* material was loaned to the Tiroler Landesmuseum Ferdinandeum in Innsbruck, where it was then considerably damaged by floods in 1985. Fortunately, most of the labels remained legible and most of the abdomens were still preserved. In this situation, the colleagues at the Innsbruck museum made the farsighted decision to make about 1,600 genitalia slides of the partially damaged moths during the following years, which we were able to work on. Among this material, we found a specimen that Wehrli had received from Turati (see Wehrli 1954) and that he obviously did not return. Its labels, above all the almost square, bright red label with a thin black edge surprisingly enough reveal that this must be the one of the two male type specimens of *Psodos perlinii* mentioned by Wehrli (1954) (Figs 1–3). The extraordinary find, finally, allows unveiling the mystery around *P. perlinii*, almost a century after its description.

Abbreviations

MNC	Museum für Naturkunde Chemnitz (Coll. S. Erlacher), Germany
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria
ZFMK	Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany
ZSM	Zoologische Staatssammlung, Munich, Germany

Material and Methods

Photographs were taken with a Nikon D200 camera attached to a Nikon stereo microscope SMZ1000 for the genitalia and a Nikon Coolpix 4500 camera for the specimens.

Material. *Psodos perlinii* Turati, 1914: Lectotype ♂ (hereby designated in order to stabilize nomenclature according to article 74 ICZN), 'Italia sept. | Valcamonica | [L.] Salar[no] | Geo. C. Krüger', '*perlinii* Trti', <red label:> '<unreadable>', 'PRÄP. NR. 1447 I M. Hreblay präp.', <red label:> 'LECTOTYPUS I *Psodos perlinii* Turati, 1914 I designated by I Erlacher & Junghans (2009)', ZFMK. – **Italy**: 1♂; Trentino, Adamello, Refugio Madrone, 2500 m, 01.vii.1964, leg. J. Wolfsberger; ZSM. 1♂; ibd.; genitalia slide no. GU:27/1999, ZSM. 1♂; ibd., 07.–10.viii.1964, leg. K. Burmann; TLMF. 1♂; ibd. 1♀; ibd.; CJ-64, TLFM. 1♀; ibd., 01.viii.1964. leg J. Wolfsberger; GU:28/1999, ZSM. 1♂; ibd., 2500–2800 m, 01.viii.1965, leg. J. Wolfsberger; CJ-72, ZSM. 1♂; ibd., 01.viii.1967, leg. J. Wolfsberger; ZSM. 1♂; ibd.; CJ-71, ZSM. 1♂; ibd., 2900 m, mid–viii.1958, leg. K. Burmann; G0054, TLMF. 1♀; ibd., 31. vii.1964, leg. K. Burmann; G0055, TLMF. 1♂; ibd., 2500 m, 9.vii.1994, leg. S. Erlacher; SE-356, MNC. 1♂; ibd.; MNC. – *Psodos bentelii* Rätzer, 1890: **Italy**: 1♀; Dolomiti, 28.vii.1907, leg. A. Petry; G1264, ZFMK. 1♂; ibd., Passo di Valparolo, 13.vii.1994, leg. S. Erlacher, CJ-38, MNC. 1♂; ibd., 2200 m, 13. vii.1994, leg. S. Erlacher; GU:15/1999, MNC. Trentino-Alto Adige, Bolzano, Lago di Antermoja, 15. vii.1924, leg. Dannehl, ZSM. 1♀; Südtirol, Seiser Alm, 10.vii.1921, unknown collector; G0242, ZFMK. 1♂; ibd.; G0243, ZFMK. **Switzerland**: 1 sp.; Graubünden, Engadin, Alp Grüm, 05.viii.1926, leg. C. Hörhammer, ZSM. 1♂; ibd., Diavolezza, 3000 m, 31.vii.1922, leg. E. Wehrli; G0319, ZFMK. 1♂; ibd., Piz Campascio, 01.viii.1922, leg. E. Wehrli; G0298, ZFMK. 1♂; ibd.; G0314, ZFMK. 1♂; ibd.; G0315, ZFMK. 1♀; ibd.; G1827, ZFMK. 1♂; ibd., Piz Lagalp, 29.vii.1922, unknown collector; G0317, ZFMK. 1♂: Uri, Furka, 14.vii.1912, unknown collector; G0305, ZFMK. 1♂; Wallis, Eggerhorn, 24.vii.1912, unknown collector; G0856, ZFMK. 1♂; ibd., Gornergrat, 11.viii.1898, unknown collector; G0303, ZFMK. 1♂; ibd., 02.viii.1899, unknown collector; G0724, ZFMK. 1♀; ibd., 08.viii.1917, leg. E. Wehrli; G0287, ZFMK. 1♂; ibd., 16.vii.1919, leg. E. Wehrli; G0262, ZFMK. 1♀; ibd.; G0263, ZFMK. 1♂; ibd.; G0264, ZFMK. 1♂; ibd.; G0265, ZFMK. 1♂; ibd.; G0266, ZFMK. 1♂; ibd.; G0267, ZFMK. 1♂; ibd.; G0268, ZFMK. 1♂; ibd.; G0269, ZFMK. 1♂; ibd.; G1683, ZFMK: 1♂; ibd., 28.vii.1919, leg. E. Wehrli; G1421, ZFMK. 1♂; ibd.; G1433, ZFMK. 1♂; ibd.; G0272, ZFMK. 1♂; ibd.; G0273, ZFMK. 1♂; ibd.; G0274, ZFMK. 1♂; ibd.; G0275, ZFMK. 1♂; ibd.; G0276, ZFMK. 1♀; ibd.; G0277, ZFMK. 1♂; ibd., 03. viii.1919, leg. E. Wehrli; G0271, ZFMK. 1♂; ibd., 28.viii.1919, leg. E. Wehrli; G1659, ZFMK. 1♂; ibd., 25.vii.1920, leg. E. Wehrli, ZFMK. 1 v; ibd.; G0282, ZFMK. 1♂; ibd.; G0283, ZFMK. 1♂; ibd.; G0285, ZFMK. 1♂; ibd.; G1669, ZFMK. 1♂; ibd.; G1705, ZFMK. 1♂; ibd.; G1721, ZFMK. 1♂; ibd.; G1722, ZFMK. 1♂; ibd.; G1737, ZFMK. 1♂; ibd.; G1738, ZFMK. 1♂; ibd.; G1753, ZFMK. 1♂; ibd., 28.vii.1920, leg. E. Wehrli; G0278, ZFMK. 1♂; ibd.; G0279, ZFMK. 1♂; ibd.; G0280, ZFMK. 1♂; ibd.; G0281, ZFMK. 1♂; ibd.; G1671, ZFMK. 1♂; ibd.; G1682, ZFMK. 1♀; ibd.; G1698, ZFMK. 1♂; ibd.; G1729, ZFMK. 1♂; ibd.; G1730, ZFMK. 1♂; G1746, ZFMK. 1♂; ibd.; G1837, ZFMK. 1♂; ibd., 08.viii.1920, leg. E. Wehrli; G1679, ZFMK. 1♂; ibd.; G1833, ZFMK. 1♂; ibd.; G1836, ZFMK. 1♂; ibd., 25.viii.1920, leg. E. Wehrli; G1660, ZFMK. 1♂; ibd., 28.viii.1920, leg. E. Wehrli; G1661, ZFMK. 1♂; ibd., 20.x.1920, leg. Bâle; G0270, ZFMK. 1♀; ibd.; G0288, ZFMK. 1♂; ibd., 12.vii.1921, leg. E. Wehrli; G0307, ZFMK. 1♀; ibd.; G0308, ZFMK. 1♂; ibd.; G0309, ZFMK. 1♂; ibd.; G0310, ZFMK. 1♂; ibd.; G0311, ZFMK. 1♂; ibd.; G0312, ZFMK. 1♂; ibd.; G1386, ZFMK. 1♂; ibd.; G1396, ZFMK. 1♂; ibd.; G1830, ZFMK. 1♂; ibd.; G1838, ZFMK. 1♂; ibd., 17.vii.1921, leg. E. Wehrli; G1436, ZFMK. 1♂; ibd., 27.vii.1931, leg. Wehrli; G1503, ZFMK. 1 sp.; ibd., 16.vii.1935, leg. Eisenberger, ZSM. 1♂; ibd., 22.vi.1937, leg. E. Wehrli; G1610, ZFMK. 1♂; ibd., 22.vii.1937, leg. E. Wehrli; G1594, ZFMK. 1♂; ibd.; G1612, ZFMK. 1♂; ibd.; G1630, ZFMK. 1♂; ibd.; G1631, ZFMK. 1♂; ibd.; G1632, ZFMK. 1♂; ibd.; G1633, ZFMK. 1♂; ibd.; G1634, ZFMK. 1♂; ibd., 24.vii.1937, leg. E. Wehrli; G1404, ZFMK. 1♂; ibd.; G1406, ZFMK. 1♂; ibd.; G1407, ZFMK. 1♂; ibd.; G1608, ZFMK. 1♂; ibd.; G1623, ZFMK. 1♂; ibd.; G1629, ZFMK. 1♂; ibd., 20.vii.1938, leg. E. Wehrli; G1435, ZFMK. 1♂; ibd.; G1507, ZFMK: 1♂; ibd.; G1508, ZFMK. 1♂; ibd.; G1509, ZFMK. 1♂; ibd.; G1515, ZFMK. 1♂; ibd.; G1516, ZFMK. 1♀; ibd.; G1528, ZFMK. 1♂; ibd.; G1531, ZFMK. 1♀; ibd.; G1553, ZFMK. 1♀; ibd.; G1574, ZFMK. 1♂; ibd., 27.vii.1939, leg. E. Wehrli; G1378, ZFMK. 1♂; ibd.; G1397, ZFMK. 1♂; ibd.; G1429, ZFMK. 1♂; ibd.; G1430, ZFMK. 1♂; ibd.; G1499, ZFMK. 1♂; ibd.; G1618, ZFMK. 1♂; ibd., 31.vii.1939, leg. E. Wehrli; G1394, ZFMK. 1♂; ibd.; G1395, ZFMK. 1♂; ibd., 12.viii.1942, leg. E. Wehrli; G1495, ZFMK. 1♂; ibd.; G1496, ZFMK. 1♂; ibd., 28.vii.1948, leg. E. Wehrli; G1754, ZFMK. 1♂; ibd., 01.viii.1962, leg. Sielmann; G1314, ZFMK. 1 sp.; ibd., 19.vi.1962, unknown collector, ZSM. 1♂; ibd., 3100 m, 18–24.vii.1955, leg. Groß; ZSM. 1♂; ibd., Matterhorn, 2600–2700 m, 15.vii1997, leg. J. Gelbrecht *et al.*; GU:21/1999, coll. J. Gelbrecht, Königs Wusterhausen. 1♂; ibd., Mettelhorn, 18.vii.1919, leg. E. Wehrli; G1670, ZFMK. 1♂; ibd.; G1706, ZFMK. 1♂; ibd., 04.viii.1934, leg. E. Wehrli; G1613, ZFMK. 1♂; ibd., Riffelalp, vii/viii.1942, leg. E. Wehrli; G1494, ZFMK. 1♂; ibd., Rotenbachn, 22.vii.1937, leg. E. Wehrli; G1611, ZFMK. 1♂; ibd., 06.viii.1937, leg. E. Wehrli; G1599, ZFMK. 1♂; ibd.; G1609, ZFMK. 1♂; ibd., 20.vii.1938, leg. E. Wehrli; G1533, ZFMK. 1♂; ibd.; G1539, ZFMK. 1♂; ibd.; G1569, ZFMK. 1♂; ibd., 25.vii.1938, leg. E. Wehrli; G1586, ZFMK. 1♂; ibd., 30.vii.1938, leg. E. Wehrli; G1543, ZFMK. 1♂; ibd.; G1545, ZFMK. 1♂; ibd.; G1556, ZFMK. 1♂; ibd.; G1579, ZFMK. 1♂; ibd.; G1581, ZFMK. 1♂; ibd., Rotenboden, 23.vii.1919, leg. E. Wehrli; G0301, ZFMK. 1♂; ibd., 20.[vii].1938, leg. E. Wehrli; G1505, ZFMK. 1♂; ibd., Saas-Fee, 31. vii.1956, leg. J. Wolfsberger; ZSM. 1♀; ibd., Schwarzsee, 19.vii.1918, unknown collector; G0352, ZFMK. 1♂; ibd., Stellisee, 19.vii.1938, leg. E. Wehrli; G1385, ZFMK. 1 sp.; ibd., Stockhorngrat, 07.viii.1919, leg. E. Wehrli, ZSM. 1♂; ibd., Trifthorn, 31.vii.1920, leg. E. Wehrli; G0299, ZFMK. 1♂; ibd.; G0300, ZFMK. 1♂; ibd.; 3730 m, 09.viii.1919, leg. E. Wehrli; G1681, ZFMK. 1♂; ibd., Triftjoch, 07.viii.1920, leg. E. Wehrli; G1689, ZFMK. 1♂; ibd., Weg-Britannia Hütte, 2600 m, 22.vii.1941, leg. E. Wehrli; G0803, ZFMK. 1♂; ibd.; G0804, ZFMK. 1♂; ibd.; G0805, ZFMK. 1♂; ibd.; G0807, ZFMK. 1♂; ibd.; G0814, ZFMK. 1♂; ibd., 2700 m, 22.vii.1941, leg. E. Wehrli; G0811, ZFMK. 1♀; ibd., 2800 m, 26.vii.1941, leg. E. Wehrli; G0815, ZFMK. 1♂; ibd.; G0817, ZFMK. 1♂; ibd.; G0244, ZFMK. 1♀; ibd., Weg-Mischabel Hütte, 2300 m, 29.vii.1941, leg. E. Wehrli; G0821, ZFMK. 1 sp.; ibd., Zermatt, 07.viii.1912, unknown collector, ZSM. 1♂; ibd., 12.vii.1918, leg. E. Wehrli; G0289, ZFMK. 1♂; ibd.; G0290, ZFMK. 1♂; ibd.; G0291, ZFMK. 1♂; ibd.; G0292, ZFMK. 1♂; ibd.; G0293, ZFMK. 1♀; ibd.; G0294, ZFMK. 1♂; ibd.; G0295, ZFMK. 1♂; ibd.; G0296, ZFMK. 1♂; G0297, ZFMK. 1♂; G0326, ZFMK. 1♀; ibd.; G0332, ZFMK. 1♀; ibd.; G0339, ZFMK. 1♀; ibd.; G0433, ZFMK. 1♂; G1651, ZFMK. 1♂; G1690, ZFMK. 1♂; G1697, ZFMK. **France**: 1♂, Alpes-Maritimes, Cime di Argentera, 3350 m, 30.vii.1923, leg. E. Wehrli; G0259, ZFMK. 1♂; ibd., 31.vii.1923, leg. E. Wehrli; G0255, ZFMK. 1♀; ibd.; G0256, ZFMK. 1♀; ibd.; G0257, ZFMK. 1♂; ibd.; G0258, ZFMK. 1♂; ibd., Mont Gélas, 20.vii.1923, leg. A. Ströbl; G0260, ZFMK. 1♀; ibd., 24.vii.1923, leg. R. Kitschelt; G0860, ZFMK. 1♀; Haute-Pyrénées, Cauterets, date unknown, unknown collector; G0221, ZFMK. 1♀; ibd., Gèdre, 31.vii.1898, leg. E. Wehrli; G0225, ZFMK. 1♂; ibd., Pic du Midi, 26.vii.1901, unknown collector; G1250, ZFMK. 1♂; Haute-Savoie, Mont Blanc, 2000 m, 26.vii.1926, leg. W. Ripper; G0381, ZFMK. 2 sp.; Provence, Alpes-Maritimes, Saint-Martin, 01.vii.1913, unknown collector, ZSM. 1♂; Pyrénées-Orientalis, Arele Nord du Contigou, 31.vii.–01.viii.1909, leg. E. Wehrli; G0210, ZFMK. 1♀; ibd., Cambras d'Aze, 10.vii.1929, v.d.Goltz; G0222, ZFMK. 1♂; ibd., Esquerdes de Routje, 23.vii.1909, leg. H. Powell; G0212, ZFMK. 1♂; ibd.; G0213, ZFMK. 1♂; ibd.; G0214, ZFMK. 1♂; ibd.; G0215, ZFMK. 1♂; ibd.; G0216, ZFMK. 1♂; ibd.; G0217, ZFMK. 1♀; ibd., Haute-Vallée-de-Montet, 26.vii.1909, leg. H. Powell; G0207, ZSM. 1♂; ibd.; G0208, ZSM. 1♂; ibd.; G0209, ZSM. 1♀; ibd., Mont Canigou, 24.vii.1929, unknown collector; G0219, ZFMK. 1♀; ibd.; G0220, ZFMK. 1♂; ibd., Vernet-les-Bains, date unknown, E. Wehrli; G0211, ZFMK. 1♂; ibd.; G0223, ZFMK. 1♂; Savoie, Bonneval-sur-Arc, 1400 m, 22.viii.1912, unknown collector; G1302, ZFMK. 1♂; ibd., Pralognan, 1440 m, date unknown, unknown collector; G1278, ZFMK. **Spain**: 1♂; Aragon, Ull de Ter, 23–25.vii.1909, unknown collector; G0218, ZFMK. **Romania**: 1♂; Retyezat, Zenoga, 2200 m, 28.vii.1932, leg. Bartha; ZSM.

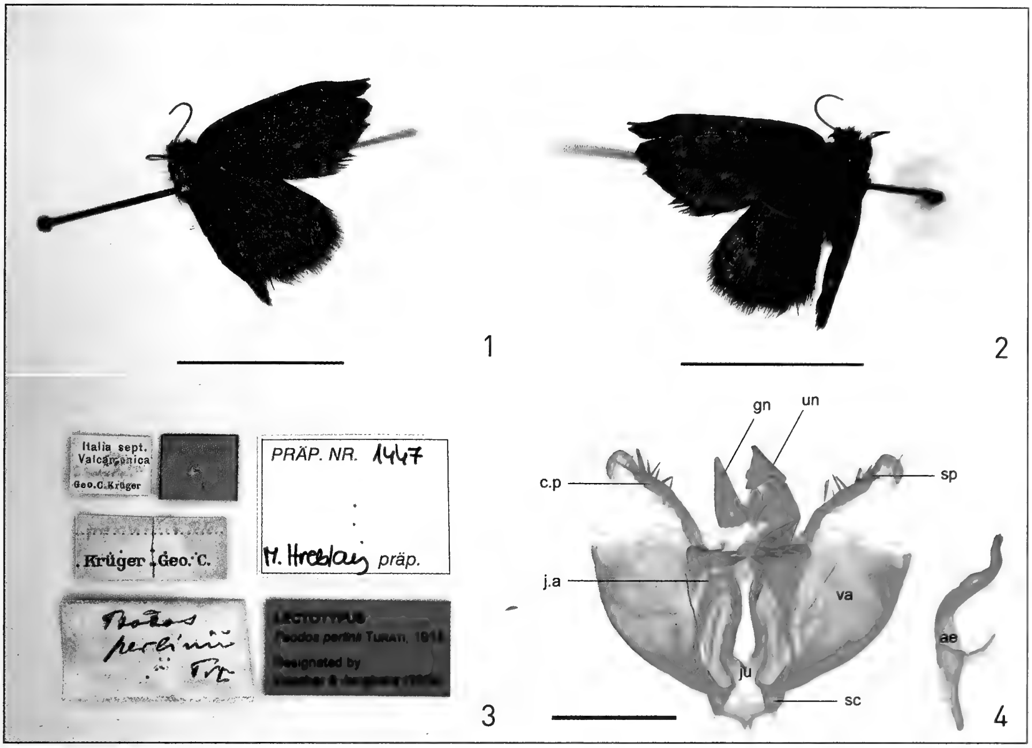
Results

The study of Turati's original description and examinations of the genitalia of specimens collected in the Adamello region compared with the type specimen of *P. perlinii* showed that the latter is identical with the species *Psodos bentelii* Rätzer, 1890. Nevertheless, the geographical isolation of the Adamello population and its phenotypic characteristics justify assigning the status of *P. perlinii* as a subspecies of *P. bentelii*:

Psodos bentelii perlinii Turati, 1914 stat. n. (Figs 1–8)

Redescription. Male (Figs 1–2). Measurements. Body length: 9,8 mm. Wingspan (longest distance vertical to body): 21.9–24.1 mm. Length of forewing (along the costa): 12.2–13.4 mm. Width of forewing (longest distance parallel to body): 8.4–9.1 mm. Upperside of wings with slight from greenish-blue to metallic shiny scales. Ground colour of upperside of wings: unsettled soot-black with dappled light scales. Forewings with marked distal point. Hindwings with weak distal point. Antemedian line not as clearly serrated as postmedian line, rather rounded. Antemedian line not continued on hindwings. Distal line serrated, continued on hindwings, towards the edge delimited by thin light shades. Terminal fascia mostly interrupted in a wedge-shaped way. Ground colour of underside of wings: soot-black, partially with lightly shiny scales. Antemedian line absent. Postmedian line unserrated. Distal points as on upperside. Proboscis well developed. Head, thorax and abdomen, legs and antennae in the ground colour.

Male genitalia (Fig. 4). Uncus pointed, shorter than gnathos. Gnathos long, slender, pointed, almost reaching up to tip of uncus. Costal process (sclerotised proximal part of fore-edge of valve) about two thirds of fore-edge of valve and clearly separated

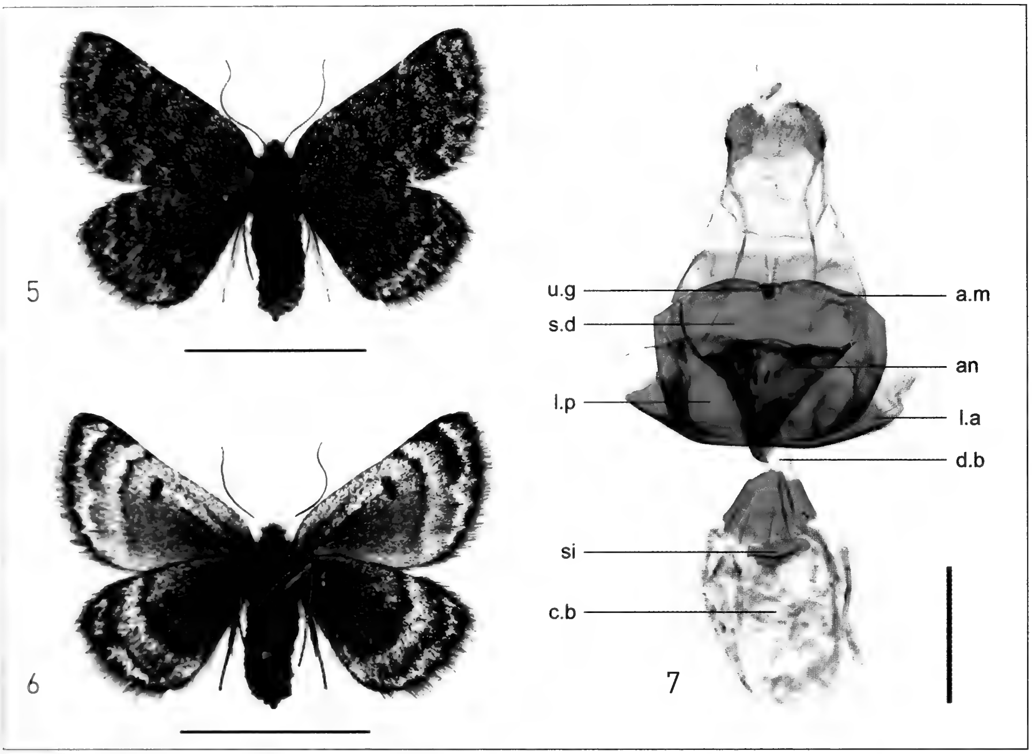


Figs 1–4. Lectotype of "*Psodos perlinii* Turati, 1914" deposited at the ZFMK. **1.** Upperside, **2.** Underside (scale bars: 10 mm). **3.** Labels. **4.** Male genitalia; genitalia slide 1447 (prep. M. Hreblay); ae – aedoeagus, c.p – costal process, gn – gnathos, ju – juxta, j.a – juxta arm, sc – sacculus, sp – spines, un – uncus, va – valve (scale bar: 1.0 mm).

from that; distal with numerous strongly sclerotisised spines which can form two to three rows. Proportion length of valve to juxta arm length (without sacculus) 1.78. Juxta arms slender, distally broadened, slightly arched on the inside, terminal with a group of strongly sclerotised and medially directed spines; underneath a larger canine tooth and a further dorsally-directed spine on the inner side of the juxta. Aedoeagus S-shaped, first arch roughly in the centre, second arch roughly in last sixth of length, with numerous small spines at the tip. Proportion juxta arm length (without sacculus) to length of aedoeagus (from bases to tip) 0.6.

Female (Figs 5–6). Measurements. Body length: 8,9 mm. Wingspan (longest distance vertical to body): 20.7–21.8 mm. Length of forewing (along of costa): 10.4–12.2 mm. Width of forewing (longest distance parallel to body): 6.6–7.6 mm. Ground colour and habitus same as in male.

Female genitalia (Fig. 7). Corpus bursae pear-shaped, membranous, anally a fourth up to a third sclerotised, in sclerotised part shaping folds. Signum with strongly sclerotised, inverted, mouth-shaped strip in anal half of corpus bursae, vertical along the longitudinal body line. Ductus bursae membranous, short, not clearly standing out against corpus bursae. Antrum funnel-shaped, orally becoming narrower only after half of antrum length; proportion length of corpus bursae (from apex to anal end of



Figs 5–7. Female of *Psodos bentelii perlinii*; data: Italy, Adamello, Rif. Mandrone, 2,500 m, 7.–10. vii.1964, leg. K. Burmann; genitalia slide CJ-64 (prep. C. Junghans); in coll. TLMF. **5.** Upperside, **6.** Underside (scale bars: 10 mm). **7.** Female genitalia of the same specimen; a.m – anal margin, an – antrum, c.b – corpus bursae, d.b – ductus bursae, l.a – lamella antevaginalis, l.p – lamella postvaginalis, s.d. – sclerotised disc, si – signum, u.g – uncus gap (scale bar: 1.0 mm).

sclerotisation) to length of antrum 0.46 mm. Lamella postvaginalis: lateroventral part ("Mittlerer Haftwulst" *sensu* Wehrli 1921) widely U-shaped, orally shaping a straight line: mediodorsal part shaping a sclerotised disc, widely heart-shaped; anal margin of sclerotised disc ("Freie Analwülste" *sensu* Wehrli 1921) not clearly arched, almost shaping a straight line; inverted anal part of sclerotised disc ("Uncuslücke" *sensu* Wehrli 1921) as little pit without orally continuing fissure. Lamella antevaginalis as narrow, grooved band, clasping Lamella postvaginalis orally and ventrally.

Diagnosis. *P. bentelii perlinii* can clearly be distinguished from the other subspecies of *P. bentelii* (ssp. *bentelii* Rätzer, 1890, ssp. *alpmaritima* Wehrli, 1924, ssp. *panticosea* Wehrli, 1919, ssp. *retyezatensis* Bartha, 1933, ssp. *zermattensis* Wehrli, 1919) by its dark soot-black ground colour. Phenotypically the most similar subspecies *P. bentelii zermattensis* (from region of Zermatt) is, however, on average smaller and has a yellowish scaling in its ground colour above all in the terminal area of the upperside of wings which cannot be found on *P. bentelii perlinii*. The female genitalia of *P. bentelii perlinii* slightly differ from those of the nominate subspecies. In contrast to *P. bentelii perlinii*, the oral part of antrum of *P. bentelii bentelii* becomes narrower only at its end whereas *P. bentelii perlinii* starts becoming narrower between the middle and the oral

Fig. 8. Habitat of *Psodos bentelii perlinii* near Refugio Mandrone, Northern Italy, 9.vii.1994.

end of the antrum. Furthermore, the lateroventral part of lamella postvaginalis is more rounded in *P. bentelii bentelii* than in *P. bentelii perlinii*.

Distribution. In the region of Adamello in Northern Italy *Psodos bentelii perlinii* is so far only known from the locus typicus "above the Lago Salarno" (3,000 m) and the Refugio Mandrone (2,500–2,900 m).

Life history. Host-plant(s) and early stages are unknown. Flight period: early July to mid–August. Preferred habitats are rocky areas with grassy tussocks and lichens (Fig. 8).

Discussion

It is worth mentioning that Wehrli already interpreted Turati's original description at an early stage in a way that indicated that *P. perlinii* might be *Psodos bentelii* Rätzer, 1890 (Wehrli 1921: 167). Today, this interpretation can clearly be confirmed after examination of the type specimen. Indeed, when looked at unambiguously, there is hardly a point in Turati's ambiguous original description that seriously contradicts this fact.

There is general agreement on what *P. bentelii* is. Good illustrations can be found in Burmann & Tarmann (1983). As well as *P. coracina*, *P. bentelii* has a strong tendency towards the formation of subspecies. Based on the geographical isolation of the

Adamello population and its phenotypic adaptation to the parent granite stone, we argue that it is justifiable to assign *P. perlinii* as a subspecies of *P. bentelii*.

Psodos bentelii perlinii was discovered in a glacier moraine above the Lago Salarno at 3,000 m in the Val di Saviore, a side valley of Val Camonica, about 9 km southwest of the Refugio Mandrone. According to present knowledge three species of *Psodos*, *P. bentelii perlinii*, *P. canaliculata* and *P. coracina*, occur sympatrically close to the Refugio Mandrone, the well-known collection area of K. Burmann and J. Wolfsberger. Due to the distinct phenotypic similarity of the species observed in this region, often an examination of genitalia is required to confirm the species identification. Only in higher regions from about 3,000 m, for instance at Passo del Maroccaro above the Refugio Mandrone, there is a further species of *Psodos*, i. e. *Psodos alticolaria chalybaeus* Zerny, 1916 (examined from specimens collected by Kaesweber in 1986) which is characterised by an unusual dark black ground colour with strikingly contrasted underside of the wings. Presumably, it is here where *P. alticolaria chalybaeus* shares its habitat with *P. bentelii perlinii*.

Acknowledgements

We are grateful to Prof. Dr. Gerhard Tarmann and Dr. Peter Huemer, Tiroler Landesmuseum Ferdinandeum, Innsbruck, Dr. Dieter Stüning, Museum Alexander Koenig, Bonn, Dr. Axel Hausmann, Zoologische Staatssammlung, Munich, and Manfred Sommerer, Munich, for the loan of material and generous support. Thanks to two anonymous reviewers for their useful comments and to John Green, London, for assistance in checking the English.

References

Burmann, K. & G. Tarmann 1983. Neues zur Taxonomie der Gattung *Psodos* Treitschke, 1827. – Entomofauna **4**: 467–479.

Forster, W. & T. A. Wohlfahrt 1980. Die Schmetterlinge Mitteleuropas. Band V. Spanner (Geometridae). – Franckh'sche Verlagshandlung, Stuttgart. 312 pp.

Müller, B. 1996. Geometridae. – *In:* Karsholt, O. & J. Razowski (eds.), The Lepidoptera of Europe. A distributional checklist. – Apollo Books, Stenstrup, 380 pp.

Povolny, D. & J. Moucha 1955. On the high mountain Geometridae of the genus *Psodos* Treitschke, 1828 [sic!] with regard to their species in the mountains of Chechoslovakia and to the question of the origin of a species in mountain regions (Lepidoptera – Geometridae). – Acta Entomologica Musei Nationalis Pragae **30**: 143–174.

Raineri, V. & S. Zangheri 1995. Lepidoptera Drepanoidea, Axioidea, Geometroidea. – *In:* Minelli, A., Ruffo, S. & S. La Posta (eds.). Checklist delle speciie della fauna italiana. – Calderini, Bologna **90**: 1–23.

Schwingenschuss, L. 1923. Die paläarktischen *Psodos*-Formen. – Verhandlungen der Zoologisch-Botanischen Gesellschaft Wien 73: 79–84.

Scoble, M. J. (ed.) 1999. Geometrid Moths of the World: a catalogue (Lepidoptera, Geometridae). Vols 1 + 2. – CSIRO Publishing and Apollo Books, Stenstrup. 1016 pp.

Turati, E. 1914. Contribuzioni alla Fauna d'Italia e descrizione di specie e forme nuove di Lepidotteri (Con due tavole). – Atti de la Societa Italiana di Scienze Naturali (Pavia) **53**: 468–619.

Wehrli, E. 1919. Über neue Formen und wenig bekannte Arten (*Psodos*). – Mitteilungen des Entomologenvereins Basel und Umgebung **11**: 1–8.

Wehrli, E. 1921. Monografische Bearbeitung der Gattung *Psodos*, nach mikroskopischen Untersuchungen der ♂ und ♀. – Mitteilungen der Schweizerischen Entomologischen Gesellschaft **13**: 143–175.

Wehrli, E. 1954. Geometridae. – *In*: Seitz, A. (ed.), Die Gross-Schmetterlinge der Erde. Suppl. 4. – A. Kernen, Stuttgart. 766 pp., 53 pls.

Wolfsberger, J. 1966. Eine neue Art der Gattung *Psodos* Tr. vom Monte Baldo in Oberitalien (Lep., Geometridae). – Estratto **14**: 449–454.

Nota lepid. **32** (1): 55–62

Atomorpha punctistrigaria (Christoph, 1893) (Geometridae: Ennominae) – a new geometrid species for the fauna of Europe

TATYANA A. TROFIMOVA

Samara State University, Laboratory of Animal Systematics and Faunistics, ul. Ac. Pavlova 1,
443011, Samara, Russia; e-mail: apame@mail.ru

Abstract. A little-known geometrid moth, *Atomorpha punctistrigaria* (Christoph, 1893), was found in the Volgo-Ural sands (Ryn-sands, Western Kazakhstan) and is new to Europe. The type material of *A. punctistrigaria* (Christoph, 1893), *A. falsaria* (Alpheraky, 1892) (type species of the genus), and *A. hedemanni hedemanni* (Christoph, 1885) was examined in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia. Lectotypes for *A. punctistrigaria* (Christoph, 1893) and *A. falsaria* (Alpheraky, 1892) are designated. Images of the adults and genitalia structures are also given.

Introduction

Atomophora Alphéraky, 1892 was established as a monotypic genus for *Atomophora falsaria* Alphéraky, 1892 described from Gansu [China]. Later, Staudinger (1901: 282) proposed the name *Atomorpha* for genus *Atomophora* Alphéraky, 1892 because the latter is a junior homonym of *Atomophora* Reuter, 1884 (Hemiptera). The genus inhabits desert and semidesert zones of Central Asia, the Middle East, and northern Africa (Tunisia) (Remm & Viidalepp 1981; Scoble 1999; Viidalepp 1975, 1988, 1996; Viidalepp et al. 1992). At present, the genus includes four species: *A. falsaria* (Alphéraky 1892), *A. hedemanni* (Christoph, 1885), with subspecies *A. h. khalia* Wiltshire, 1986, *A. mabillearia* Lucas, 1907, and *A. punctistrigaria* (Christoph, 1893). An examination of moths collected in the eastern part of the Volgo-Ural sands (Kazakhstan, Ryn-sands) has revealed one specimen of a little known geometrid moth, *Atomorpha punctistrigaria*. The species is very rare in collections and insufficiently known in bionomics. It was described from Turkmenistan in the environs of Ashkhabad from seven specimens that are deposited now in the collection of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg – ZISP). A comparative study of the genitalia structure of specimens from the Volgo-Ural sands with that of the type specimens of *A. punctistrigaria* confirmed my determination. The occurrence of *A. punctistrigaria* in the Volgo-Ural sands adds to its distribution. It was recently known only from very few localities in Turkmenistan and from the Malye Barsuki sands in Southern Kazakhstan. The new finding of *A. punctistrigaria* is especially interesting because this point is the most northwestern and is in the territory of European Russia; thus the species is for the first time recorded for the fauna of Europe (Fig. 1).

The Volgo-Ural sands (Fig. 6) are represented by hilly-ridge fixed sands and in some areas weakly fixed sands on interfluve of the Volga and Ural rivers. The hilly sands are covered with psammophytic shrubs and grass-sagebrush vegetation: *Poa bulbosa* L. (Poaceae), *Leymus racemosus* (Lam.) Tzvel. (Poaceae), *Agriophyllum squarrosum* (L.) Moq. (Poaceae), *Artemisia lercheana* Web. ex Stechm. (Asteraceae), *Elaeagnus angustifolia* L. (Elaeagnaceae), *Tamarix ramosissima* Ledeb. (Tamaricaceae), *Calligonum aphyllum* (Pall.) Guerke (Polygonaceae), and others plants. In

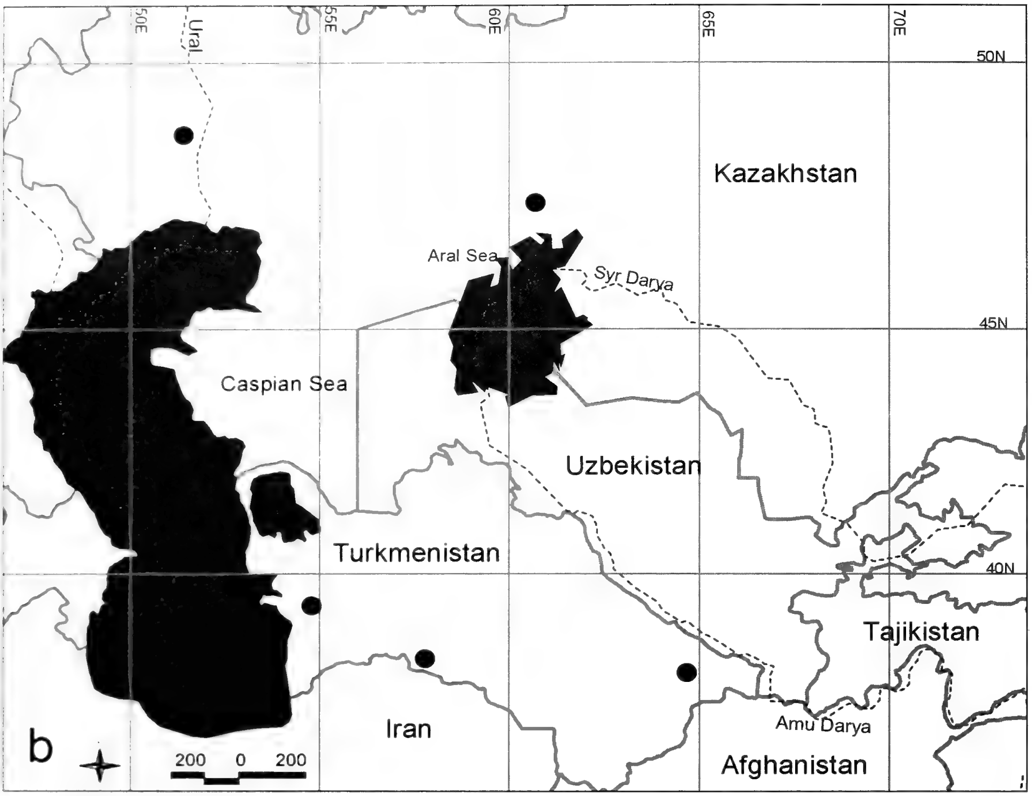


Fig. 1. Distribution of *Atomorpha punctistrigaria* (scale bar in km).

depressions, where groundwater surfaces, there are communities of reed grass (*Phragmites australis* (Cav.) Trin. ex Steud. (Poaceae)) and saltworts such as *Salicornia*, *Suaeda*, *Climacoptera*, and *Halocnemum* (all Chenopodiaceae). Based on the previous finding of *Atomorpha punctistrigaria* (Christoph 1893) and my data, it has become more obvious that the occurence of this species is restricted to desert hilly sands.

I investigated the type specimens of *Atomorpha punctistrigaria, A. hedemanni*, and *A. falsaria* deposited in St. Petersburg (ZISP). The latter taxon is the type species of *Atomorpha* Staudinger, 1901. Here I am giving images of adults and genitalia structures of these three species. The genitalia of *Atomorpha punctistrigaria* have not been figured previously and those of *A. falsaria* have been figured schematically only once (Viidalepp 1975). Lectotypes are designated here for nomenclatorial stabilization.

Abbreviations

Coll. P. Skou	The collection of P. Skou (Denmark)
LSSU	Laboratory of Animal Systematics and Faunistics, Samara State University (Samara, Russia
ZISP	Zoological Institute of Russian Academy of Sciences (St. Petersburg, Russia)

Atomorpha Staudinger, 1901

Type species: *Atomophora falsaria* Alphéraky, 1892

References: Alphéraky, 1892: 66 (*Atomophora*); Staudinger 1901: Viidalepp 1975: 486; Scoble 1999: 76 (*Atomorpha*).

Redescription (Figs 2–7, 9–14). Medium to small sized geometrid moths. Wingspan 18–20 mm. Forewings triangular, hindwings rounded. Venation as in ennominae ground plan. Forewing with 4 branches of R-veins, R-Cu cell wide and long, Sc and R1 joined, R1 anastomosed with R2, R2+R3 on stalk, R4 originating from top of R-cell. Hindwing with R and M1 without anastomosis. Antennae rather ciliate in male and with very short rami in female. Eyes rounded, large. Frons protruding. Head, thorax, abdomen, and legs covered with pale scales. Hind tibia with two pairs of spurs. Male and female genitalia characters discussed in species accounts and illustrated below (Figs 9–14).

Atomorpha falsaria (Alphéraky, 1892) (Figs 2–3, 9–11)

Atomophora falsaria Alphéraky, 1892: 66. Type locality: [China], Gan-Sou.

References. Viidalepp 1975: 486; Scoble 1999: 76 (*Atomorpha*).

Material. Lectotype (here designated) with the following labels: ♂ *Atomophora falsaria* Alphéraky, 1892, with labels: '24.VI. 1886 Edsin prov.| Gan-Sou | leg. Potanin' <green rectangle hand-written in black ink>, 'Кол. Вел. Кн. | Николая | Михайловича' [collection of Grand Duke Nikolay Mikhailovich] <white rectangle, printed>, LECTOTYPUS. | *Atomophora* | *falsaria* Alpheraky, 1892 | T. Trofimova design 2009' <red rectangle, printed>, ZISP. – Paralectotypes: 3 ♀ with the same data (ZISP). – Additional material. 11♂, 1♀ **Mongolia**, Southern-Gobi aimak, 60 km Eastern of brooks Talyn-Bilgah-Bulak, leg. M. Kozlov, 17.–19.viii.1969 (ZISP).

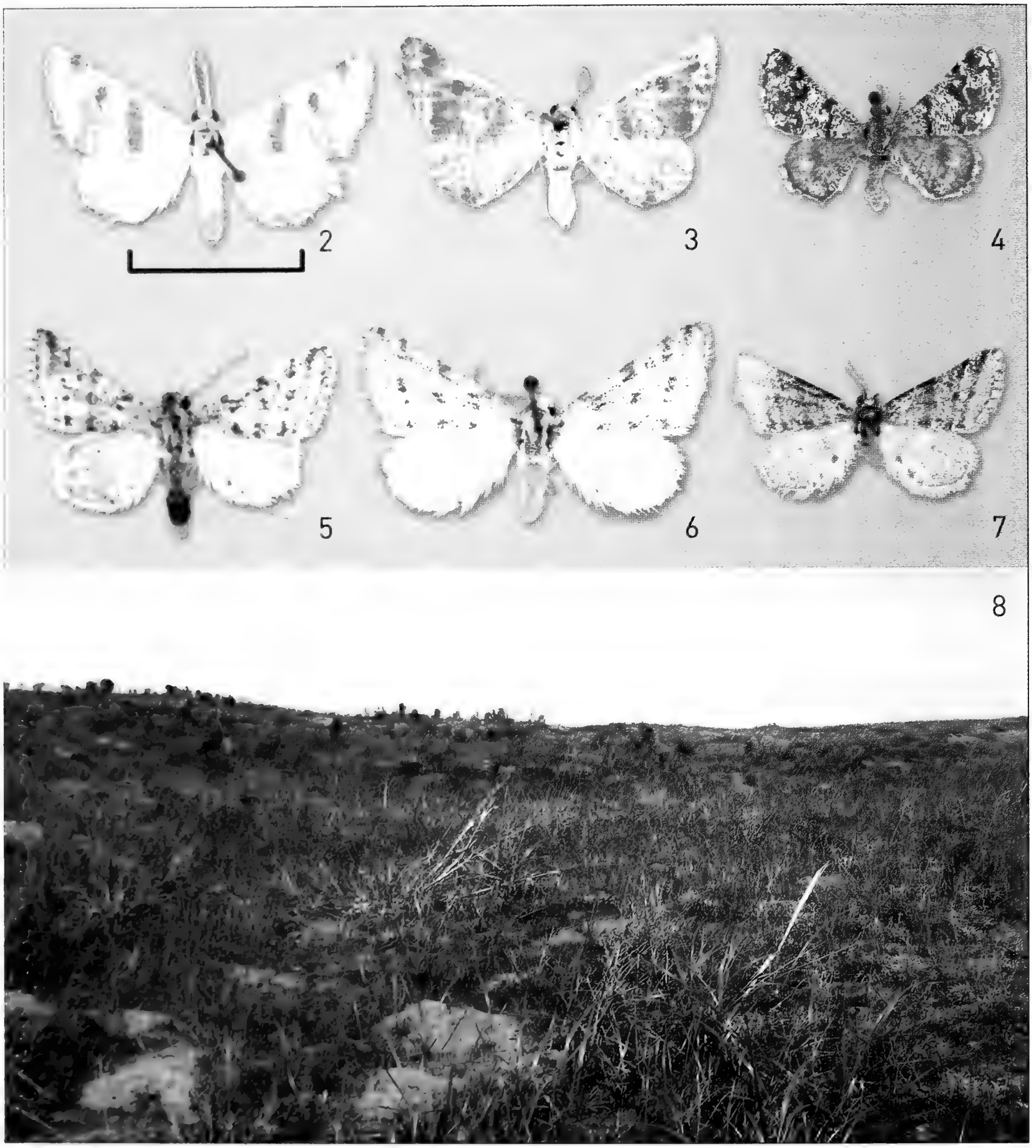
Redescription (Figs 2–3). Wingspan 20 mm in both sexes. Forewings triangular, with yellowish white ground color, irrorate by brown scales, fringe pale yellowish. Two straight transversal bands typical, submarginal one diffused in costal area and with large diffuse brown discal spot. Hindwing of same ground color, with scattered brown scales and fringe. Female somewhat darker and with same characters of wings colour and pattern. Head, thorax, abdomen, and legs covered with yellowish white scales.

Male genitalia (Figs 9–10). Tergum VIII strongly sclerotized, dome-shaped, covering genitalia structures (Figs 9c, d). Valva very characteristically shaped: with expanded sacculus curved by right angle to long cucullus, which is two times narrower than sacculus, dorsal edge ribbon, sclerotized, with slightly extended basal process. Uncus triangular, wide, gnathos triangular, taeniate, narrow apically, tegumen and vinculum wide, juxta ovate slightly sclerotized, phallus slender weakly curved, almost in 1,2 time shorter of valvae, vesica without cornuti.

Female genitalia (Fig. 11). Segment VIII cone-shaped, strongly sclerotized, anterior apophyses very short, rather rudimental. Papillae anales oval-shaped, posterior apophyses developed, antrum funnel-shaped with sclerotization, ductus bursae membraneous, corpus bursae ovate without signa.

Distribution and life history. The species occurs in China and Mongolia. The biology and immature stages are unknown.

Remarks. *Atomophora falsaria* Alphéraky, 1892, was described based on 1 male and 3 females: "Un ♂ et 3♀ de l'Atomophora Falsaria furent trouvés par l'expédition



Figs 2–8. *Atomorpha* Staudinger, 1901 (scale bar 10 mm). **2**. *A. falsaria* male, lectotype (ZISP). **3**. *A. falsaria* female, paralectotype (ZISP). **4**. *A. hedemanni hedemanni*, male, holotype (ZISP). **5**. *A. punctistrigaria* male, lectotype (ZISP). **6**. *A. punctistrigaria* (Christoph, 1893), female, paralectotype (ZISP). **7**. *A. punctistrigaria* from the Volgo-Ural sands (LSSU). **8**. Habitat of *A. punctistrigaria* in the Volgo-Ural sands.

Potanine, entre le 24 Juin et le 1 Juillet, 1886, dans la province de Gan-Sou."; they are preserved in ZISP. One male is designated here as lectotype in order to clarify the taxonomy of the species. The figures of the male genitalia structures (Figs 9–10) given here are from a preparation made by Viidalepp of a specimen from the Southern Gobi aimak of Mongolia (preparation K-213, Viidalepp det. in ZISP). They have been published already (Viidalepp 1975) and appended with a detailed description of the relative sizes of some sclerites of the genitalia. The female genitalia of the paralectotype are in Euparal (Fig. 11).

Atomorpha hedemanni hedemanni (Christoph, 1885)

Fidonia hedemanni Christoph, 1885: 121. Type locality: [Turkmenistan], Askhabad.

References. Staudinger 1901: 282; Wiltshire 1986: 285; Viidalepp 1988: 217; 1996: 84; Scoble 1999: 76 (*Atomorpha*).

Material. Holotype ♂ *Fidonia hedemanni*, Christoph 1885, with the following labels: <green circle>, '♂ | Askha | bad' <white rectangle, hand-written in black ink> '92 | 10 v. 82 | Chr' <white rectangle, hand-written in black ink>, '104 / 6.' <white rectangle, hand-written in black ink>, 'Кол. б. Вел. Кн. | Николая Михайловича' [collection of Grand Duke Nikolay Mikhailovich] <white rectangle, printed> (ZISP). – Additional material. 3♂, 1♀ **Turkmenistan** Askhabad.

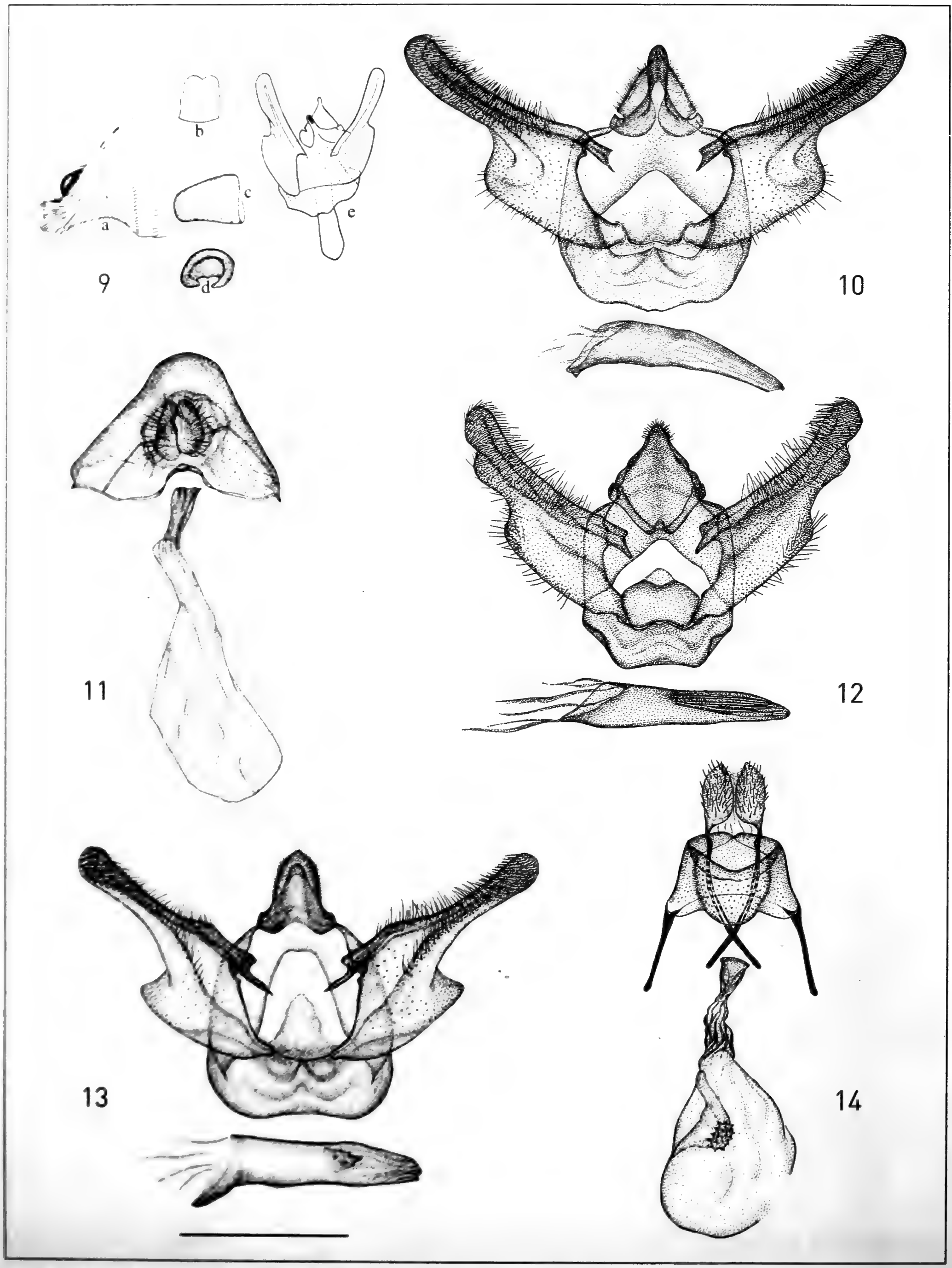
Redescription (Fig. 4). Wingspan 20 mm in both sexes. Head, body, and legs with brown scales, abdomen pale brown. Forewings with yellowish white ground color irrorated with streaks of brown scales, fringe variegated and consisting of white and brown scales. Forewings with 2 clear dark brown bands, marginal band zigzag, submarginal band almost straight but slightly curved towards costa, discal spot brown and merged with marginal band, marginal area consisting of separate brown spots. Hindwings with yellowish grey ground color densely irrorated with pale brown scales, with distinct marginal curved band and with slightly marked submarginal band.
Male genitalia (Fig. 12). Tergum VIII sclerotized, triangular. Sternum VIII strongly sclerotized as in *falsaria*, triangular, posteriorly concave. Valvula with two ventral lobes, cucullus exceeding valvula. Uncus triangular, wide. Gnathos arms conspicuously narrow. Tegumen and vinculum wide. Juxta trapezoid, weakly sclerotized. Phallus slender, straight almost long as long valva, vesica with 7 needle-shaped cornuti.
Female genitalia. Not examined.
Distribution and life history. This eremic species occurs in Turkmenistan, Uzbekistan, Iran, and Balutschistan. The life history and immature stages are unknown.
Remarks. Variable species in coloration of the fore- and hindwing. In Balutschistan and Iran it is known as form *hedemanni baloutschistana* Werhli, 1953. Subspecies *hedemanni khalia* was described by Wiltshire (1986) from Saudi Arabia and Southern Iran and differs from *baloutschistana* by the whiter ground colour of the wings and the less irrorated dark scales of the wings than in form *baloutschistana*. In the original description Wiltshire (1986) described that this subspecies has no significant genitalic differences from those of the nominotypical *hedemanni*.

Atomorpha punctistrigaria (Christoph, 1893) (Figs 5–7, 13–14)

Atomophora punctistrigaria Christoph, 1893: 95. Type locality: [Turkmenistan], Askhabad.

References. Staudinger 1901: 282; Viidalepp 1988: 217; 1996: 84; Scoble 1999: 76 (*Atomorpha*).

Material. Lectotype (here designated) with the following labels: ♂ *Atomophora punctistrigaria* Christoph, 1893, with labels: <green circle>, '♂ | Askha | bad' <white rectangle with black frame, hand-written in black ink>, '104' <white rectangle with blue line, hand-written in black ink>, 'Кол. Вел. Кн. | Николая | Михайловича' [collection of Grand Duke Nikolay Mikhailovich]' <white rectangle, print-



Figs 9–14. Genitalia of *Atomorpha* spp. (scale bar 0,5 mm). **9**. Male terminalia of *A. falsaria* from Viidalepp (1975), Mongolia, Southern-Gobi aimak (ZISP), **a.** abdomen male; **b.** sternum VIII; **c.** tergum VIII in lateral view; **d.** tergum VIII from behind; **e.** genitalia structure. **10**. Male genitalia of *A. falsaria*, phallus below; Mongolia, Southern-Gobi aimak (ZISP). **11.** Female genitalia of paralectotype *A. falsaria*, Gan-Sou (ZISP). **12.** Male genitalia of *A. hedemanni*, phallus below, Turkmenistan, Ashkhabad (ZISP). **13.** Male genitalia of paralectotype *A. punctistrigaria* phallus below; 'Askhabad' (ZISP). **14.** Female genitalia of paralectotype *A. punctistrigaria* 'Askhabad'(ZISP).

ed> 'Atomophora | punctistrigaria | Chr' <blue rectangle, hand-written in black ink>, 'LECTOTYPUS. | Atomophora | punctistrigaria | Christoph, 1893 | T. Trofimova design. 2009' <red rectangle, printed>, ZISP – Paralectotypes: 3♂, 3♀ with same data (ZISP). – Additional material. 1♂, 1♀ [**Kazakhstan**] Stepper, sands Malye Barsuki near Kara-Chokata, Turgai district, 1908.vii.22, leg. N.V. Andreev, (ZISP); 1♂, 30.v.2007, Kazakhstan, Atyrau district, N 48°28'35" E 51°18'46", leg. T. Trofimova & D. Shovkoon (LSSU); 1♂ [Turkmenistan], Repetek, 1988.v.12, leg. H. Ostrauskas (et coll. P.Skou).

Redescription (Figs 5–7). Wingspan 18 mm (male), 20 mm (female). Forewings triangular, from pale yellowish to pale grayish, irrorated with brown scales, fringe chequered as in *A. hedemanni*. Forewings with 4 almost straight bands consisting of separate greyish brown spots. Hindwings of same ground color, with separate spot on edge and indistinct grey submarginal band more visible on upper side. Head, thorax, abdomen, and legs covered with pale brown scales. Antennae ciliate in male and with very short pectination, rather filiform in female. Frons tapering, labial palpus protruding. Females with rather lighter tone of both wings with less clear bands on forewings.

Male genitalia (Fig. 13). Similar to those of *Atomorpha falsaria*. Valva with wider sacculus with pointed ventro-caudal angle, cucullus long and two times narrower than sacculus, caudally expanded, dorsal edge without basal bifurcation. Uncus and gnathos triangular. Vinculum and tegumen wide and rounded. Juxta triangular, lightly sclerotized, almost membranous. Phallus slender, with one dentate plate-like? cornutus.

Female genitalia (Fig. 14). Papillae anales disk-shaped, anterior and posterior apophyses developed, anterior apophysis 1.5 times shorter than posterior ones, antrum funnel-shaped with sclerotization, ductus bursae folded, anteriorly sclerotized, corpus bursae ovate with one disc-shaped, spinous signum.

Distribution and life history (Fig. 8). This psammophilous species is very rare in the hilly sands of Turkmenistan and Kazakhstan. The immature stages are unknown. Little is known on the bionomics. Viidalepp et al. (1992) mentioned that *A. punctistrigaria* occurs in 2 generations: the first in April–May and the second in October. Therefore in my opinion, this species can expand further northwest towards to the Volga delta where where the well-known (hilly-ridge fixed) Naryn sands are found.

Remarks. *Atomophora punctistrigaria* Christoph, 1893, was described based on 4 males and 3 females preserved in ZISP. One male is designated as lectotype. This species was mentioned in some publications (Viidalepp 1988; Viidalepp et al. 1992), but without detailed discussion and illustrations. It is mostly known from the very short and insufficient original description. Therefore, I am providing a redescription and figures here, including the type specimen and genitalia structures of male and female for the first time.

Acknowledgements

The author is very grateful to Dr Vladimir G. Mironov (St. Petersburg, Russia) for the help in identifying our material and for providing access to the collection of ZISP, to Dr Vadim V. Zolotuhin (Ulyanovsk, Russia) for his valuable comments on the manusript, to Mr Igor Yu. Kostjuk (Kiev, Ukraine) for information on specimens in collections of the Zoological Museum of Kiev State University and for providing rare literature sources, to Dr Axel Hausmann for information on the species in the collections of the Zoologische Staatssammlung (Munich, Germany), to Mr P. Skou who courteously provided materials from his collection, to Svetlana V. Nedoshivina (St. Petersburg, Russia) for providing rare literature sources, to Dmitriy

F. Shovkoon (Samara, Russia) for preparing the photos, and to Alexey S. Pazhenkov (Samara, Russia) for heading the expedition.

References

Alphéraky, S. 1892. Lépidoptères rapportés de la Chine et de la Mongolie par G.N. Potanine. II. Heterocera. – *In*: Romanoff, Mémoires. Lépidoptères **6**: 66–68.

Christoph, H. 1893. Lepidoptera Nova Faunae Palearcticae. – Deutsche entomologische Zeitschrift Iris **6** (1): 95.

Remm, H. & J. Viidalepp 1981. On the fauna of Heterocera of Yashan and Uzboi valley. – Gidrobiological investigations, Tallin **10**: 28–32. (in Russian)

Scoble, M. J. (ed.). 1999. Geometrid Moths of the World: A Catalogue (Lepidoptera, Geometridae). – CSIRO Publishing, Apollo Books, Stenstrup Vol. 1: xxv + 482 pp.

Staudinger, O. 1901. Catalog der Lepidopteren des palaearctischen Faunengebietes **1**. – Berlin, 282 pp.

Viidalepp, J. R. 1975. On the fauna of Geometrid moths (Lepidoptera, Geometridae) (Lepidoptera, Geometridae) of the Mongolian People's Republic. Pp. 438–490. – *In*: Insects of Mongolia, Leningrad. (in Russian).

Viidalepp, J. R. 1988. Fauna of Geometrid moths of the mountains of Middle Asia. – Moskow. 240 pp. (in Russian).

Viidalepp, J. R. 1996. Checklist of the Geometridae (Lepidoptera) of the former U.S.S.R. – Apollo Books, Stenstrup. 111 pp.

Viidalepp, J. R., G. A. Krassilnikova & M. A. Daritsheva 1992. Ecologo-faunistitsheskii obzor pyadenits (Lepidoptera, Geometridae) Turkmenii. – Ecologia i raspredelenie nasekomyh Turkmenistana [Ecology and distribution of Insects of Turkmenia], Ashkhabad: 89–152. (in Russian)

Wiltshire, E. P. 1986. Lepidoptera of Saudi Arabia: Fam. Cossidae, Sesiidae, Metarbelidae, Lasiocampidae, Sphingidae, Geometridae, Lymantriidae, Arctiidae, Nolidae, Noctuidae (Heterocera); Fam. Satyridae (Rhopalocera) (Part 5). – *In*: Büttiker & Krupp (eds.), Fauna of Saudi Arabia **8**: 262–323.

On the systematics of *Anania* Hübner, 1823 (Pyraloidea: Crambidae: Pyraustinae)

ANDREAS TRÄNKNER [1,2], HOUHUN LI [3] & MATTHIAS NUSS [1,4]

[1] Museum of Zoology, Koenigsbruecker Landstrasse 159, 01109 Dresden, Germany
[2] e-mail: andreas.traenkner@senckenberg.de
[3] College of Life Sciences, Nankai University, Tianjin 300071, China; e-mail: lihouhun@nankai.edu.cn
[4] e-mail: matthias.nuss@senckenberg.de

Abstract. Currently, Pyraustinae (Lepidoptera: Pyraloidea: Crambidae) are split into many genera that often contain a small number of species only. This classification is largely influenced by traditional and typological concepts and do not necessarily reflect natural relationships. Thus, we encourage the idea to fuse taxa based on synapomorphies, as suggested by Leraut (2005), who argued, that an elongated, serrated sclerite of the phallus in males and a digitiform structure freely extending into the antrum in females is apomorphic for members of *Anania* Hübner, 1823. Screening the literature, we found four further species belonging to this monophylum: *Anania hasanensis* (Kirpichnikova, 1998) (*Opsibotys*) **comb. n.**, *Anania luteorubralis* (Caradja, 1916) (*Pyrausta*) **comb. n.**, *Anania obtusalis* (Yamanaka, 1987) (*Perinephela*) **comb. n.**, and *Anania shafferi* (Speidel & Hanigk, 1990) (*Algedonia*) **comb. n.** Investigating Chinese Pyraustinae, we also found these characters in taxa which so far were not assigned to *Anania*. As a result, *Pronomis* Munroe & Mutuura, 1968 **syn. n.**, *Tenerobotys* Munroe & Mutuura, 1971 **syn. n.**, and *Udonomeiga* Mutuura, 1954 **syn. n.** are synonymized with *Anania*. The species formerly tretaed in *Pronomis* are transferred to *Anania*: *Anania delicatalis* (South, 1901) (*Pyrausta*) **comb. n.**, *Anania flavicolor* Munroe & Mutuura, 1968 (*Pronomis*) **comb. n.**, *Anania profusalis* (Warren, 1896) (*Opsibotys*) **comb. n.** The species and subspecies formerly treated in *Tenerobotys* are transferred to *Anania*: *Anania subfumalis* Munroe & Mutuura, 1971 (*Tenerobotys*) **comb. n.**, *Anania subfumalis continentalis* (Munroe & Mutuura, 1971) (*Tenerobotys*) **comb. n.**, *Anania teneralis* (Caradja, 1939) (*Hapalia*) **comb. n.**, and *Anania teneralis tsinlingalis* (Munroe & Mutuura, 1971) (*Tenerobotys*) **comb. n.** *Anania vicinalis* (South, 1901) **comb. n.** (*Pyrausta*) is transferred from *Udonomeiga* to *Anania*. The apomorphic characters of *Anania* are also shared by the afrotropic *Ethiobotys* Maes, 1997, **syn. n.**, and the species formerly treated therein are transferred to *Anania*: *Anania amaniensis* (Maes, 1997) **comb. n.**, *Anania ankolae* (Maes, 1997) **comb. n.**, *Anania bryalis* (Hampson, 1918) (*Lamprosema*) **comb. n.**, *Anania camerounensis* (Maes, 1997) **comb. n.**, *Anania elutalis* (Kenrick, 1917) (*Pyrausta*) **comb. n.**, *Anania epipaschialis* (Hampson, 1912) (*Nacoleia*) **comb. n.**, *Anania lippensi* (Maes, 1997) **comb. n.**, and *Anania ruwenzoriensis* (Maes, 1997) **comb. n.** In contrast, *Crypsiptya* Meyrick, 1894 **stat. rev.** is reinstated as a valid taxon, based on our investigation of *Crypsiptya coclesalis* (Walker, 1859: 701) (*Botys*) **comb. rev.**

Introduction

The Pyraustinae in the sense of Solis & Maes (2003) comprises about 1,400 species placed in 239 valid genera. According to morphological characters of the copulatory organs, the subfamily forms a rather uniform group. Their male terminalia do not bear a gnathos, but show a sella and an editum on the mesal wall of the valva and there are often deciduous cornuti on the vesica. Their female terminalia typically present an appendix bursae and a rhomboid signum in the wall of the corpus bursae. Additional pyraustine characters are given by Minet (1982) and Maes (1994). However, a cladistic analysis of crambid subfamilies showed only one synapomorphy for the Pyraustinae: a continuous median teguminal ridge forming two parallel lines (Solis & Maes 2003). Within the Pyraustinae, the generic classification is mainly based on traditional, typological views of wing pattern elements. Based on these studies, the group has been split into numerous genera, most of them containing less than five species.

Nota lepidopterologica, 15.5.2009, ISSN 0342-7536

In 2005, Leraut synonymized pyraustine genera *Algedonia* Lederer, 1863, *Ebulea* Doubleday, 1849, *Eurrhypara* Hübner, 1825, *Opsibotys* Warren, 1890, and *Perinephela* Hübner, 1825 with *Anania* Hübner, 1823. All these genera and the species included in them are well known to European lepidopterists (Goater 1986; Palm 1986; Karsholt & Razowski 1996). At first glance, the species formerly included in these genera do not look congeneric (Figs 1–8), but Leraut (2005) showed the common presence of a digitiform sclerotization in the female antrum (Figs 18–21), which seems to be related to the common presence of a spattle-like sclerotization ("languette" sensu Leraut) in the phallic apodeme (Figs 13–17). He hypothesized that these structures are synapomorphies for the species he included in *Anania*.

Additionally, Leraut (2005) listed *Crypsiptya* Meyrick, 1894 as a synonym of *Anania*. Then, he synonymized *Coclebotys* Munroe & Mutuura, 1969 with *Anania*, although *Coclebotys* had been already synonymized with *Crypsiptya* by Shaffer et al. (1996: 189), which is supported by Maes (2002).

Though the digitiform sclerotization in the female antrum and the spattle-like sclerotization of the phallus apodeme still deserve further investigation to clarify their function, we support the idea to group species that share common, homologous characters. Here we provide a morphological description of these charaters and discuss their presence in additional pyraustines that have not been assigned to *Anania* before.

Material and Methods

Our investigation for the presence or absence of phallus sclerotization and the inner antrum digitiform structure involved pyraustine genera *Achyra* Guenée, 1849, *Anania* sensu Leraut (2005), *Callibotys* Munroe & Mutuura, 1969, *Carminibotys* Munroe & Mutuura, 1971, *Circobotys* Butler, 1879, *Crocidophora* Lederer, 1863, *Crypsiptya*, *Demobotys* Munroe & Mutuura, 1969, *Ecpyrrhorrhoe* Hübner, 1825, *Euclasta* Lederer, 1855, *Eumorphobotys* Munroe & Mutuura, 1969, *Gynenomis* Munroe & Mutuura, 1968, *Loxostege* Hübner, 1825, *Mimetebulea* Munroe & Mutuura, 1968, *Nascia* Curtis, 1835, *Nephelobotys* Munroe & Mutuura, 1970, *Ostrinia* Hübner, 1825, *Paracorsia* Marion, 1959, *Paranomis* Munroe & Mutuura, 1968, *Paratalanta* Meyrick, 1890, *Parbattia* Moore, 1888, *Pronomis* Munroe & Mutuura, 1968, *Psammotis* Hübner, 1825, *Pseudebulea* Butler, 1881, *Pyrausta* Schrank, 1802, *Sclerocona* Meyrick, 1890, *Tenerobotys* Munroe & Mutuura, 1971, *Thliptoceras* Warren in Swinhoe, 1890, *Udonomeiga* Mutuura, 1954, and *Uresiphita* Hübner, 1825.

Nomenclatural data were edited using the online database of the Global Information System on Pyraloidea (Nuss et al. 2009).

Genitalia were prepared and mounted according to the standards suggested by Robinson (1976). The genitalia of several additional specimens were investigated and their genitalia stored in microvials pinned on the specimens' pin. Images of the genitalia were taken using a NIKON Eclipse 600 microscope with a ZEISS AxioCam MRc5 digital camera.

The terminology follows Marion (1954, 1959), Kristensen (2003), and Nuss & Speidel (2005).

Abbreviations

AT	Andreas Tränkner
BMNH	Natural History Museum, London
MTD	Museum für Tierkunde Dresden
NKUM	Insect Collection, College of Life Sciences, Nankai University, Tianjin
prep. gen.	preparation of genitalia
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck
ZDD	Zhang Dandan
ZFMK	Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn

Taxa currently treated in *Anania*

Leraut (2005) synonymized seven generic and subgeneric names with *Anania*. Unfortunately, he did not investigate all species-group taxa formerly treated in all of these genera and transferred only some of them to *Anania*. Thus, he established a confusing situation because a number of species-group taxa are left without generic combination. Here is an overview of the current synonymic situation:

Anania Hübner, 1823 d: 27. Type species: *Pyralis guttalis* Denis & Schiffermüller, 1775.
= *Algedonia* Lederer, 1863: 363. Type species: *Pyralis luctualis* Hübner, 1796. Leraut 2005: 127 (syn.).
= *Mutuuraia* Munroe, 1976: 34–35. Type species: *Botys terrealis* Treitschke, 1829. Maes 2005: 74 (syn.).
= *Nealgedonia* Munroe, 1976: 32. Type species: *Botys extricalis* Guenée, 1854. Maes 2005: 74 (syn.).
= *Ebulea* Doubleday, 1849: 14. Type species: *Pyralis crocealis* Hübner, 1796. Leraut 2005: 126 (syn.).
= *Ennychia* Treitschke, 1828: 318. Type species: *Phalaena octomaculata* Linnaeus, 1771. Guenée, 1854: 182. (syn.).
= *Eurrhypara* Hübner, 1825c: 360. Type species: *Phalaena urticata* Linnaeus, 1761. Leraut 2005: 129 (subgen.).
= *Proteurrhypara* Munroe & Mutuura, 1969a: 899–900. Type species: *Opsibotys ocellalis* Warren, 1892. Leraut 2005: 129 (syn.).
= *Opsibotys* Warren, 1890: 474. Type species: *Pyralis fuscalis* Denis & Schiffermüller, 1775. Leraut 2005: 129 (subgen.).
= *Perinephela* Hübner, 1825c: 357. Type species: *Pyralis lancealis* Denis & Schiffermüller, 1775. Leraut 2005: 126 (syn.).
= *Phlyctaenia* Hübner, 1825c: 359. Type species: *Pyralis sambucalis* Denis & Schiffermüller, 1775. Leraut 2005: 126 (syn.).
= *Trichovalva* Amsel, 1956: 284. Type species: *Trichovalva ledereri* Amsel, 1956. Munroe 1995: 7, 54, 164 (syn.).

Palaearctic species of *Anania*

The following is a list of the Palaearctic species placed in *Anania* according to published records:

Anania albeoverbascalis Yamanaka, 1966: 32–33 pl. 1 figs 4, 8–8a, pl. 2 fig. 16. Type locality: Japan, Honshu, Toyama Prefecture, Kurobe, Keyakidaira.

Anania chekiangensis (Munroe & Mutuura, 1969 a: 900–902, figs 4, 10, 16) (*Proteurrhypara*). Type locality: China, Zhejiang province, West Tianmushan. Leraut 2005: 129 (*Anania* (*Eurrhypara*)).

Anania coronata (Hufnagel, 1767: 616, pl. 20 fig. 14) (*Phalaena*). Type locality: Europe. Leraut 2005: 127 (*Anania*).

Anania crocealis (Hübner, 1796 a: 13, 24, pl. 11 fig. 71) (*Pyralis*). Type locality: Hungary. Leraut 2005: 125–127 fig. 5 (*Anania*).

Anania egentalis (Christoph, 1881: 19) (*Botys verbascalis* var.). Type locality: Russia, Amur region. Inoue 1988: 91 (*Anania*, sp.).

Anania funebris (Ström, 1768: 339, pl. 16 fig. 17) (*Phalaena*). Type locality: Norway. Pierce & Metcalfe 1938: 28, pl. 16 (*Anania*).

Anania fuscalis (Denis & Schiffermüller, 1775: 121) (*Pyralis*). Type locality: [Austria] Wienergegend. Leraut 2005: 130 (*Anania* (*Opsibotys*)).

Anania fuscobrunnealis (South [in Leech], 1901: 498, pl. 15 fig. 7) (*Pyrausta*). Type locality: China, Hubei Province, Changyang. Leraut 2005: 130 (*Anania* (*Opsibotys*)).

Anania fuscofulvalis Yamanaka, 2000: 63, figs 1386–1388, 1394, pl. 163 fig. 13. Type locality: Nepal, Bagmati, Godavari.

Anania hortulata (Linnaeus, 1758: 529) (*Phalaena* (*Geometra*)). Type locality: Not stated. Leraut 2005: 125 fig. 4 (*Anania* (*Eurrhypara*)).

Anania lancealis (Denis & Schiffermüller, 1775: 121) (*Pyralis*). Type locality: [Austria] Wienergegend. Leraut 2005: 127 (*Anania*).

Anania luctualis (Hübner, 1796 a: 20, pl. 14 fig. 88) (*Pyralis*). Type locality: Germany, Sachsen, Leipzig. Leraut 2005: 127 (*Anania*).

Anania oberthuri (Turati, 1913: 18) (*Botys* (*Sylepta*)). Type locality: Italy, Sardinia, Gennargentu. Leraut 2005: 127 (*Anania*).

Anania ocellalis (Warren, 1892: 295) (*Opsibotys*). Type locality: Japan. Leraut 2005: 129 (*Anania* (*Eurrhypara*)).

Anania occidentalis (Munroe & Mutuura, 1969 a: 902–904, figs 5, 11, 17). (*Proteurrhypara*). Type locality: China, Yunnan, Lijiang. Leraut 2005: 129 (*Anania* (*Eurrhypara*)).

Anania perlucidalis (Hübner, 1800–1809 b: pl. 22 fig. 143) (*Pyralis*). Type locality: Europe. Leraut 2005: 127 (*Anania*).

Anania stachydalis (Zincken [in Germar], 1821: 18, fig. 18) (*Pyralis*). Leraut 2005: 127 (*Anania*).

Anania terrealis (Treitschke, 1829: 110–111) (*Botys*). Type locality: Croatia, Dalmatia. Leraut 2005: 125 (*Anania*).

Anania testacealis (Zeller, 1847: 571–572) (*Botys*). Type locality: Italy, Sicily, Syracus, Acradina. Leraut 2005: 127 (*Anania*).

Anania verbascalis (Denis & Schiffermüller, 1775: 121) (*Pyralis*). Type locality: [Austria] Wienergegend. Pierce & Metcalfe 1938: 28, pl. 16 (*Anania*).

There are four additional Palaearctic species formerly assigned to *Opsibotys* and *Algedonia*, but not yet transferred to *Anania*. We did not investigate these species, but their genitalia have been illustrated in the literature, which allows to associate them with *Anania*:

Anania hasanensis (Kirpichnikova, 1998: 312, figs 1–2), **comb. n.** (*Opsibotys*). Type locality: Russia, Primorske territory, Khasan district, Mayachnoe.

Anania luteorubralis (Caradja, 1916: 34–35), **comb. n.** (*Pyrausta*). Type locality: China, Xinjiang, Tian Shan, Juldus [= Kaidu He]. Speidel & Hanigk 1990: 269–270, figs 17–18 (*Algedonia*).

Anania obtusalis (Yamanaka, 1987: 191–193 figs 1, 3), **comb. n.** (*Perinephela*). Type locality: Japan, Honshu.

Anania shafferi (Speidel & Hanigk, 1990: 270–271, figs 5, 10, 19–20), **comb. n.** (*Algedonia*). Type locality: Afghanistan, Gulmurg.

Anania species occurring outside the Palaearctic Region

The majority of *Anania* species occur outside of the Palaearctic Region (Munroe 1995; Maes 2003; Leraut 2005). However, due to the synonymisation of some genera with *Anania* by Leraut (2005), the correct number of valid species belonging to this genus still has to be verified. For example, there are a number of species provisionally placed in *Phlyctaenia* indicated as "misplaced" in Munroe (1995). Due to the synonymisation of *Phlyctaenia* with *Anania*, all these species formally belong to the latter genus, but their generic placement needs to be verified. Among them are *Pionea adiposalis* Dognin, 1912 and *Pionea teinopalpia* Hampson, 1913, which have been transferred to *Anania* by Leraut (2005), apparently without examination of the type specimens because these two species probably belong to the crambine genus *Erupa* Walker, 1864 (B. Landry, unpubl.). A complete synonymic catalogue of *Anania* species can be found in Nuss et al. (2009).

Taxonomic results

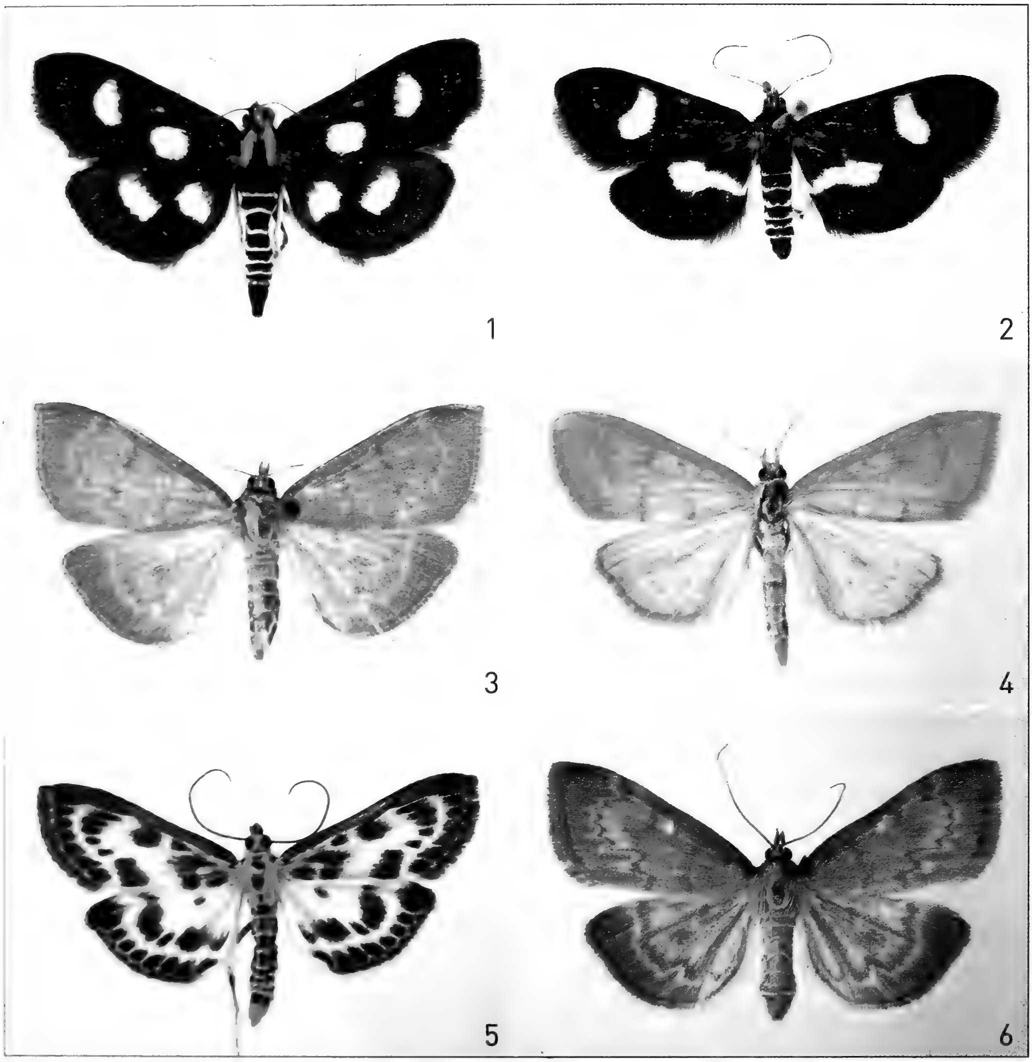
The type species of generic synonyms *Algedonia*, *Ebulea*, *Eurrhypara*, *Opsibotys*, *Perinephela*, and *Phlyctaenia* treated by Leraut (2005) in *Anania* as well as *Mutuuraia*, which was synonymized to *Algedonia* by Maes (2005), present male terminalia with a elongated, asymmetric sclerite of the phallus apodeme and female terminalia with a digitiform sclerotization inside the antrum. Among the taxa studied, we found these characters also in three species of *Pronomis*, two of *Tenerobotys*, and one of *Udonomeiga*.

Anania Hübner, 1823

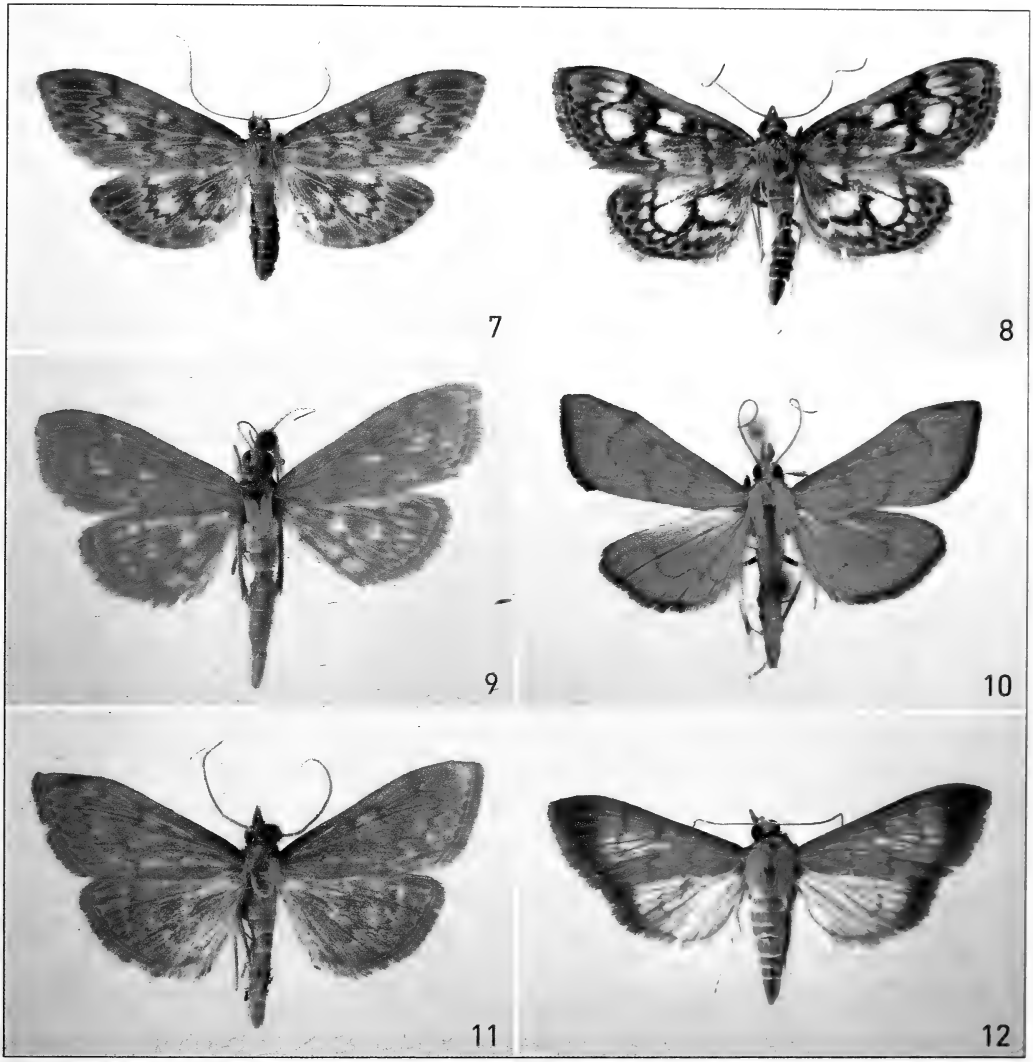
Anania Hübner, 1823 d: 27. Type species: *Phalaena octomaculata* Linnaeus, 1771.

Material. *A. funebris*: 1♂, Germany, Jena, 10.vi.1918, Ernst leg., prep. gen. AT53; 1♂, Austria, Kirchdorf, 1897, Hauder, coll. Wernicke via Kotzsch, prep. gen. AT59; 1♂, Switzerland, Ober Engadin, 1910, W. Heinitz leg., prep. gen. AT62, MTD. 1♀, Italy, Bozen, 26.vii.1898, coll. Wernicke via Kotzsch, prep. gen. AT61; 1♀, France, Digne Provence, vii.1908, prep. gen. AT52; 1♀, Austria, Kapruner Tal, vii.1942, E. Möbius, prep. gen. AT51; 1♀, Italy, South Tyrol, Klausen, 6.vi.1921, prep. gen. AT60, MTD. – *A. verbascalis*: 1♂, Switzerland, Stalden, Wallis, 20.v.1928, prep. gen. AT21; 1♀, same locality, 13.v.1928, prep. gen. AT20, MTD. – *A. terrealis*: 1♂, Germany, Loessnitz, Dresden, 20.iv.1907, prep. gen. AT33; 1♀, Germany, Meissen, leg. 1909, coll. E. Riedel, prep. gen. AT32, MTD. – *A. crocealis*: 1♂, Italy, Riva, 1911, W. Heinitz leg., prep. gen. AT19; 1♀, Italy, Mendel, 1913, W. Heinitz leg., prep. gen. AT18, MTD. – *A. hortulata*: 1♂, Germany, Sachsen, Radeberg, 11.vi.1963, prep. gen. AT38; 1♀, Germany, Dresden, Saubachtal, 29.v.1903, prep. gen. AT39, MTD. – *A. fuscalis*: 1♂, Germany, Dresden, 1990, prep. gen. AT8; 1♀, France, Alpes Maritimes, St. Martin-Vésubie, 18.vii.1914, prep. gen. AT7, MTD. – *A. lancealis*: 1♂, Germany, Chemnitz, vii.1908, prep. gen. AT29; 1♀, Germany, Dresden, Rabenauer Grund, vi.1909, prep. gen. AT28, MTD. – *A. coronata*: 1♂, Germany, Hintere Sächsische Schweiz, Großer Winterberg, 29.vi.1967, prep. gen. AT31; 1♀, Germany, Chemnitz, vii.1908, prep. gen. AT30, MTD.

Male terminalia. In *A. funebris* (Fig. 13) uncus long and small, distally pointed. Vinculum dorsally on each side with membrane adorned with loose-fitting brush of hair-like coremata slightly exceeding posterior tip of valva. Mesal wall of valva anteriorly with sella with sclerotized ventral border with small dents and process directed posteriorly. Editum with many dorsally directed lamellae. Sacculus posteriorly



Figs 1–6. Adults of European *Anania* species. **1.** *A. funebris* (= *A. guttalis*, *A. octomaculata*) ♂, Germany, Chemnitz, 21.vii.1944, W. Heinitz leg. (MTD). **2.** *A. luctualis* (formerly *Algedonia*), ♀, Germany, Schleinbach (MTD). **3.** *A. terrealis* (formerly *Algedonia*), ♀, Germany, Sachsen, Moritzburg, 25.vii.1967, Bembenek & Krause leg. (MTD). **4.** *A. crocealis* (formerly *Ebulea*), ♂, Switzerland, St. Gallen, 1891, Wernicke coll. (MTD). **5.** *A. hortulata* (formerly *Eurrhypara*), ♂, Germany, Dresden-Wachwitz, 17.v.17, M. Koch leg. (MTD). **6.** *A. fuscalis* (formerly *Opsibotys*), ♀, Germany, Dresden, Dippelsdorf, 5.vii.1941 (MTD).



Figs 7–12. Adults of European and Chinese species of *Anania* and *Crypsiptya*. **7.** *A. lancealis* (formerly *Perinephela*), ♀, Poland, Zabrze ("Hindenburg"), 10.vi.43 coll. Ernst Limbach (MTD). **8.** *A. coronata* (formerly *Phlyctaenia*), ♂, Germany, Radebeul-Kötzschenbroda, 1934, E. Möbius coll. (MTD). **9.** *A. delicatalis* (formerly *Pronomis*), ♂, Zhejiang Province, West Tianmushan, 15.v.1932, H. Höne (ZFMK). **10.** *A. teneralis* (formerly *Tenerobotys*), ♂, Inner Mongolia, Motezuoqi, Chasuqi, 950 m, 11.viii.2002, Dandan Zhang & Zhiqiang Li leg. (NKUM). **11.** *A. vicinalis* (formerly *Udonomeiga*), ♂, Zhejiang Province, Tianmushan, 29.v.1931, H. Höne (ZFMK). **12.** *C. coclesalis*, ♀, Hainan Province, Wanning, Xingzhong Farm, 110 m, 3.viii.2008, Bingbing Hu & Li Zhang leg., prep. gen. AT67 (NKUM).

with long spine directed dorsally. Mesal wall of valva densely covered with hair-like setae. Juxta U-shaped, deeply notched posteriorly.
Anellus attached along posterior third of phallus, but latter entirely anterior to diaphragma. Entrance of ductus ejaculatorius to phallus situated anterodorsally. Apodeme of praephallus strongly reduced to one lateral spine-like extension directed posteriorly. Conspicuously elongate sclerite attached to inner wall of phallic apodeme, ventrad of spine-like extension; sclerite ("languette" sensu Leraut) slightly constricted medially and reaching posterior end of phallus, asymmetrically enlarged at apex and with serrated edges. Vesica without cornuti. Phallus apodeme varying in form and size from an elongate sclerite in *A. funebris* (Fig. 13) to a deeply cleft sclerite in *A. lancealis* (Fig. 14) and *A. fuscalis*; in both cases lobes more or less serrated and concave in cross-section in correlation with cylindrical shape of phallus.
Female terminalia. In *A. funebris* (Fig. 18), appendix bursae anteriorly situated and with rhomboid signum on corpus bursae. Ductus bursae membranous, thin and long, with various folds and loops. Insertion of ductus seminalis situated fairly posterad along ductus bursae. Colliculum small and short, followed directly by antrum, showing specialized sclerotizations. Antrum sac-like, enlarged, with free digitiform sclerotization extending up to posterior edge. In diameter, anterior part of digitiform structure slightly larger than posterior end of ductus bursae. Ostium bursae situated ventro-anteriorly on digitiform structure. Lamella postvaginalis situated dorso-posteriorly in relation to antrum; its sclerotization extending ventrally towards segment VIII. Ostium situated ventro-posteriorly on digitiform structure in *A. verbascalis*, posteriorly in *A. crocealis*.

Pronomis Munroe & Mutuura, 1968, **syn. n.**

Pronomis Munroe & Mutuura, 1968: 986–987, figs 1, 20, 25. Type species: *Pyrausta delicatalis* South, 1901, by original designation.

Material. A. *delicatalis* comb. n.: **China**, 2♂, 1♀, Zhejiang Province, Tianmushan, Chanyuansi, 310 m, 15.viii.1999, leg. Houhun Li et al., prep. gen. ZDD02073, 02140, 02141; 1♂, Guangxi Zhuang Autonomous Region, Guilin, Maoershan, Jiuniutang, .1100 m, 9.iv.2002, leg. Shulian Hao & Huaijun Xue, prep. gen. ZDD02244, NKUM. 1♂, Sichuan, Kangding (= Tatsienlu, Ta-Chien-Lu), 8300 ft, vii–viii.1890, Pyralidae Brit. Mus. Slide No. 17372; 1♀, Moupin, viii.1890, Pyralidae Brit. Mus. Slide No. 17373, BMNH. 1♂, 1♀, Zhejiang Province, West Tianmushan, 15.v., 17.vi.1932, leg. H. Höne, gen. prep. AT65, ZFMK.

Anania delicatalis **comb. n.** (Fig. 9) presents the typical characters regarded as synapomorphic for *Anania*, but phallus apodeme with undivided sclerite of 2/3 length of phallus, apex of sclerite straight, truncated, slightly serrated, with asymmetrical lateral enlargement (Fig. 15). Vesica with deciduous cornuti as long as 1/3 phallus length, with dentate edges. Digitiform structure of females nearly as long as antrum, similar to open cylinder with ostium located at blunt posterior tip; antrum strongly sclerotized, nearly as long as broad and strongly swollen dorsally, with four folds on each side and many small spines (Fig. 19).

Species formerly placed in *Pronomis*:
Anania delicatalis (South [in Leech], 1901: 499, pl. 15 fig. 27) **comb. n.** (*Pyrausta*). Type locality: China.
Munroe & Mutuura, 1968: 986 (*Pronomis*).

Anania flavicolor (Munroe & Mutuura, 1968: 987–988, figs 1, 12) **comb. n.** (*Pronomis*). Type locality: China, Taiwan, Takow.

Anania profusalis (Warren, 1896: 95) **comb. n.** (*Opsibotys*). Type locality: India, Khasia Hills. Munroe & Mutuura 1968: 987 (*Pronomis*).

Tenerobotys Munroe & Mutuura, 1971, **syn. n.**

Tenerobotys Munroe & Mutuura, 1971: 174. Type species: *Hapalia teneralis* Caradja, 1939.

Material. *A. subfumalis* comb. n.: **China**, 1♂, Hunan Province, Zhuzhou, vi.1965, prep. gen. ZDD02344; 1♂, 1♀, Henan Province, Xinyang, Jigongshan, 700 m, 13.vii.2001, leg. Dandan Zhang, prep. gen. ZDD02065, 02064; 1♀, Henan Province, Tongbai, Shuiliandong, 300 m, 16.vii.2001, leg. Dandan Zhang, prep. gen. AT08034, NKUM. – *A. teneralis* comb. n.: **China**, 1♂, Hebei Province, Yi County, West Mausoleum of the Qing Dynasty, 100 m, 18.vii.2000, leg. Haili Yu, prep. gen. ZDD01224; 1♂, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, leg. Houhun Li & Xinpu Wang, prep. gen. ZDD02160; 1♂, Qinghai Province, Xunhua, Mengda, 2240 m, 15.vii.1995, Houhun Li & Shuxia Wang, prep. gen. ZDD02069; 1♂, Inner Mongolia, Motezuoqi, Chasuqi, 950 m, 11.viii.2002, leg. Dandan Zhang & Zhiqiang Li, prep. gen. ZDD02341; 1♂, Qinghai Province, Xunhua, Mengda, 2240 m, 13.vii.1995, leg. Houhun Li & Shuxia Wang, prep. gen. AT08008; 3♀, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, leg. Houhun Li & Xinpu Wang, prep. gen. ZDD01840, AT08009; Inner Mongolia, Motezuoqi, Chasuqi, 950 m, 11.viii.2002, leg. Dandan Zhang & Zhiqiang Li, prep. gen. AT08007, NKUM.

Anania teneralis **comb. n.** (Fig. 10), presents the typical characters regarded as synapomorphic for *Anania*, but phallus short and thick, with conspicuously undivided sclerite half as long as phallus length and not constricted, with apex rounded and serrated. Prephallus apodeme asymmetrically reduced as in *A. funebris*, forming only concave tongue opposite sclerite (Fig. 16). Deciduous cornuti as long as 1/3 phallus length and not serrated. Digitiform structure of females short and broad, with moderate conical tip. Ostium situated ventro-anteriorly as in *A. funebris*. Antrum broader than long. Bursa copulatrix with asymmetrical signum (Fig. 20).

Species formerly placed in *Tenerobotys*:

Anania subfumalis (Munroe & Mutuura, 1971: 177–178, figs 4–5, 12, 16) **comb. n.** (*Tenerobotys*). Type locality: China, Taiwan, Nan Tou Hsien, Hori (Puli), Wanta.

= *Anania subfumalis continentalis* (Munroe & Mutuura, 1971: 178, figs 6–7, 13, 17) **comb. n.** (*Tenerobotys*). Type locality: China, Province of Hunan, Hoengshan.

Anania teneralis (Caradja, 1939: 23) **comb. n.** (*Hapalia*). Type locality: China, Sichuan, Batang, 2800 m. Munroe & Mutuura, 1971: 174 (*Tenerobotys*).

= *Anania teneralis tsinlingalis* (Munroe & Mutuura, 1971: 176, figs 2–3, 11, 15) **comb. n.** (*Tenerobotys*). Type locality: China, Shaanxi Province, Tsinling, Tapaishan.

Udonomeiga Mutuura, 1954, **syn. n.**

Udonomeiga Mutuura, 1954: 18. Type species: *Pyrausta vicinalis* South, 1901.

Material. *A. vicinalis* comb. n.: **China,** 2♂, Guizhou Province, Chishui, Suoluo, 240 m, 21.ix.2000, leg. Haili Yu, prep. gen. ZDD02153, 02157, NKUM. 1♂, Zhejiang Province, Tianmushan 29.v.1931, Höne, prep. gen. AT64, ZFMK. **Korea,** 1♀, Utikongo, im Kongosan, 500m, 25.vii.1940, H. Höne leg., prep. gen. AT63, ZFMK.

Anania vicinalis **comb. n.** (Fig. 11) presents the typical characters regarded as synapomorphic for *Anania*, but entrance of ductus ejaculatorius in phallus situated anteriolaterally on right side. Conspicuous phallus sclerite deeply cleft, smaller lobe situated on same side as entrance of ductus ejaculatorius, bigger lobe situated on opposite side;

two lobes constricted and serrated towards broadened tips (Fig. 17). Vesica with deciduous cornuti half as long as phallus diameter and with small thorns. Ductus bursae membranous with 9–10 loops and with spirally sclerotized band towards corpus bursae. Digitiform structure extending beyond posterior edge of antrum, enclosing it narrowly. Ostium bursae situated ventro-posteriorly on digitiform structure. Lamella postvaginalis stretching dorso-posteriorly from antrum (Fig. 21) .

Species formerly placed in *Udonomeiga*:
Anania vicinalis (South [in Leech], 1901: 502, pl. 15 fig. 30) **comb. n.** (*Pyrausta*). Type locality: China.

Ethiobotys Maes, 1997, **syn. n.**

Ethiobotys Maes, 1997: 390–392. Type species: *Lamprosema bryalis* Hampson, 1918.

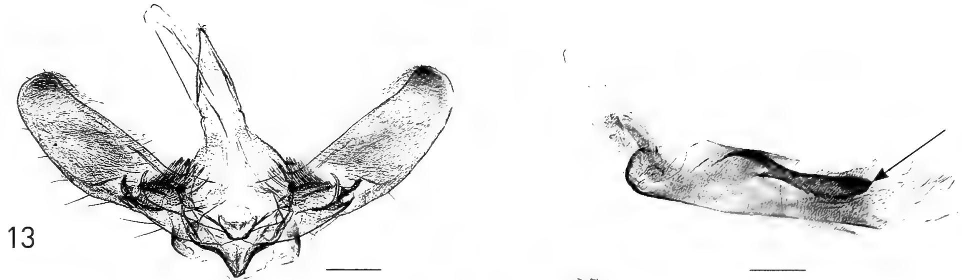
According to the original description by Maes (1997), this taxon presents the characters that are apomorphic for *Anania*. We did not investigate the eight included species, but their genitalia are sufficiently described and figured in the original descriptions, illustrating the presence of the asymmetric sclerite of the praephallus and the digitiform structure in the antrum. Thus, *Ethiobotys* is synonymized with *Anania* and the species formerly treated in *Ethiobotys* are transferred to *Anania*.

Species formerly placed in *Ethiobotys*:
Anania amaniensis (Maes, 1997: 399–401, pl. 1 fig. 3, pl. 3 fig. a, pl. 4 fig. a), **comb. n.** Type locality: Tanzania, Amani.
Anania ankolae (Maes, 1997: 398–399, pl. 1 fig. 8, pl. 3 fig. c), **comb. n.** Type locality: Uganda, Ankole, Falinzu forest.
Anania bryalis (Hampson, 1918: 136) (*Lamprosema*), **comb. n.** Type locality: Kenya, N. Kavirondo.
Anania camerounensis (Maes, 1997: 401, pl. 1 fig. 4, pl. 3 fig. b, pl. 4 fig. b), **comb. n.** Type locality: Cameroon, Mt. Cameroon Bonakanda.
Anania elutalis (Kenrick, 1917: 100, pl. 6) (*Pyrausta*), **comb. n.** Type locality: Madagascar.
Anania epipaschialis (Hampson, 1912: 439) (*Nacoleia*), **comb. n.** Type locality: Sierra Leone.
Anania lippensi (Maes, 1997: 396–398, pl. 1 fig. 2, pl. 3 fig. d, pl. 4 fig. c), **comb. n.** Type locality: Cameroon, S.W. Bonakanda 1325m.
Anania ruwenzoriensis (Maes, 1997: 394, pl. 1 fig. 7; pl. 2 fig. b), **comb. n.** Type locality: Uganda, Ruwenzori, 6500–7500ft.

Crypsiptya Meyrick, 1894, stat. rev.

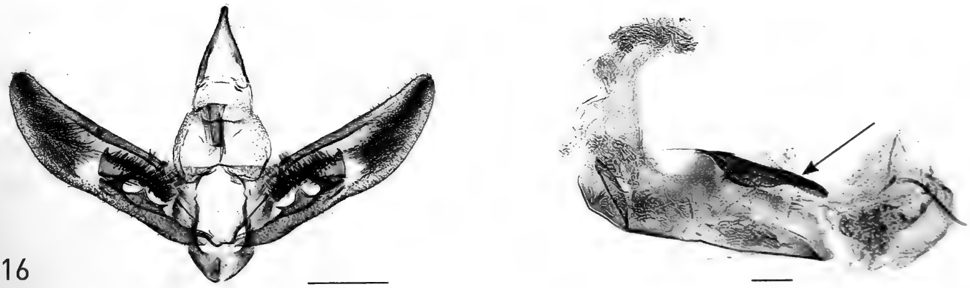
Crypsiptya Meyrick, 1894: 463. Type species: *Botys nereidalis* Lederer, 1863.
= *Coclebotys* Munroe & Mutuura, 1969 b: 1243–1245. Type species: *Botys coclesalis* Walker, 1859. Shaffer et al. 1996: 189 (syn.).

Figs 13–17. Male copulatory organs of *Anania* species (scale bars 500 µm). **13.** *A. funebris*, Austria, Kirchdorf, 1897, Hauder, coll. Wernicke, prep. gen. AT59 (MTD). **14.** *A. lancealis*, Germany, Chemnitz, vii.1908, prep. gen. AT29 (MTD). **15.** *A. delicatalis*, China, Sichuan, Kangding (= Tatsienlu, Ta-Chien-Lu), 8300 ft., vii.-viii.1890, prep. gen. 17372 (BMNH). **16.** *A. teneralis*, China, Qinghai Province, Xunhua, Mengda, 2240 m, 13.vii.1995, Houhun Li & Shuxia Wang leg., prep. gen. AT08008 (NKUM). **17.** *A. vicinalis*, China, Zhejiang Province, Tianmushan, 29.v.1931, Höne leg., prep. gen. AT64 (ZFMK).


13


14


15


16


17

Material. *C. coclesalis*: **China,** 1♂, Hainan province, Wanning, Jianfeng Ling, Beidazheng Primary school, 110 m, 28.vii.2008, Bingbing Hu & Li Zhang, leg., prep. gen. AT58; 3♀, Hainan province, Wanning, Xingzhong Farm, 110 m, 3., 8.viii.2008, Bingbing Hu & Li Zhang leg., prep. gen. AT57, 67; 1♀, Henan Province, Tongbai, Shuiliandong, 300 m, 26.vii.2000, leg. Haili Yu, prep. gen. AT08011, NKUM.

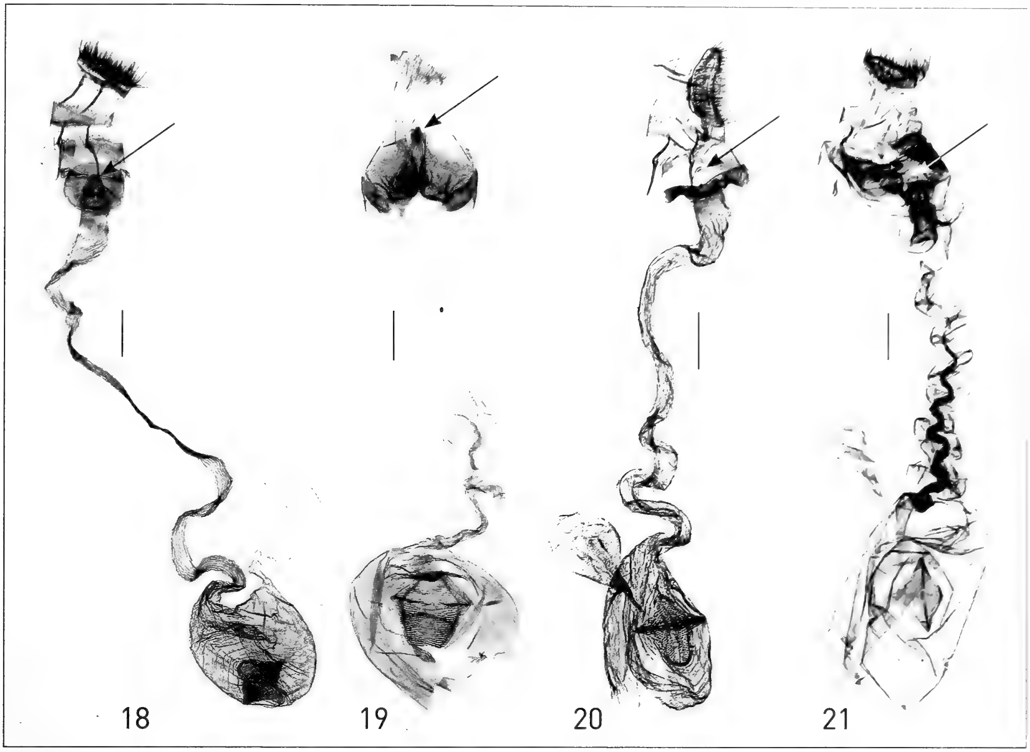
In *Crypsiptya coclesalis* (Fig. 12), phallus apodeme elongated shoehorn-shaped with acuminate curved tip. This distal process constricted at end of phallus apodeme and seamless extension of phallus sclerotization. Small thorn curved anteriorly, situated at base of distal process (Fig. 22). Colliculum of females elongate and strongly sclerotized, folded longitudinally. Inside colliculum blunt ending sclerotized tube as broad as antrum (Fig. 23). In dorsal view, tube very flat and hard to identify as hollow structure; dorsally and ventrally fixed to colliculum wall. Ostium situated at posterior most tip of tube, situated in anterior part of antrum sac.

Leraut (2005: 127) listed *Crypsiptya* Meyrick, 1894 as a synonym of *Anania* and mentioned by mistake that the synonymy was established by Shaffer et al. (1996), who in fact treated *Crypsiptya* as a valid genus. In addition, Leraut (2005) synonymized *Coclebotys* Munroe & Mutuura, 1969 with *Anania*, although *Coclebotys* had been already synonymized with *Crypsiptya* by Shaffer et al. (1996: 189). Here, we reinstate *Crypsiptya* as a valid genus following Shaffer et al. (1996), as well as Maes (2002), who provides a world checklist of *Crypsiptya*. Also, our investigation of the bamboo leaf roller *Crypsiptya coclesalis* from China shows that the structures of the terminalia that are apomorphic to *Anania* are not present in *Crypsiptya*. We were not able to study the type of *Crypsiptya nereidalis*, likely kept at the BMNH, but we do not doubt the conclusions of Shaffer et al. (1996), as well as Maes (2002) about the synonymy of *Coclebotys* with *Crypsiptya*.

Discussion

Our investigations of Pyraustinae confirm the unique characters of the male and female copulatory organs in *Anania*, as shown by Leraut (2005). In males, the apodeme of the praephallus is asymmetrically sclerotized and a conspicuously elongated sclerite ("languette" sensu Leraut) is present. In females, the antrum typically bears a digitiform structure fixed to its anterior wall, enclosing the opening of the ductus bursae into the antrum, and extending freely into the antrum sac. The ostium is translocated to the digitiform structure and its position and shape vary between species. The common presence and complexity of this structure suggests its homology among species. Since we do not know any other pyraloid taxon possessing these structures, we argue in conformity with Leraut (2005) that they are apomorphic for *Anania*.

The male and female structures identified to represent synapomorphies for *Anania* have been repeadedly studied and figured, e.g. by Mutuura (1954), Inoue (1960), and Yamanaka (1987). Speidel & Hanigk (1990) used the shape of the male phallus sclerites to discriminate *Algedonia* and *Mutuuraia* as subgenera of *Algedonia*. Munroe & Mutuura (1969a) characterized *Proteurrhypara* based on the shape of the phallic sclerites. In 2005, Maes listed a group of genera sharing the common presence of these structures in male and female genitalia. In the same year, Leraut synonymized some



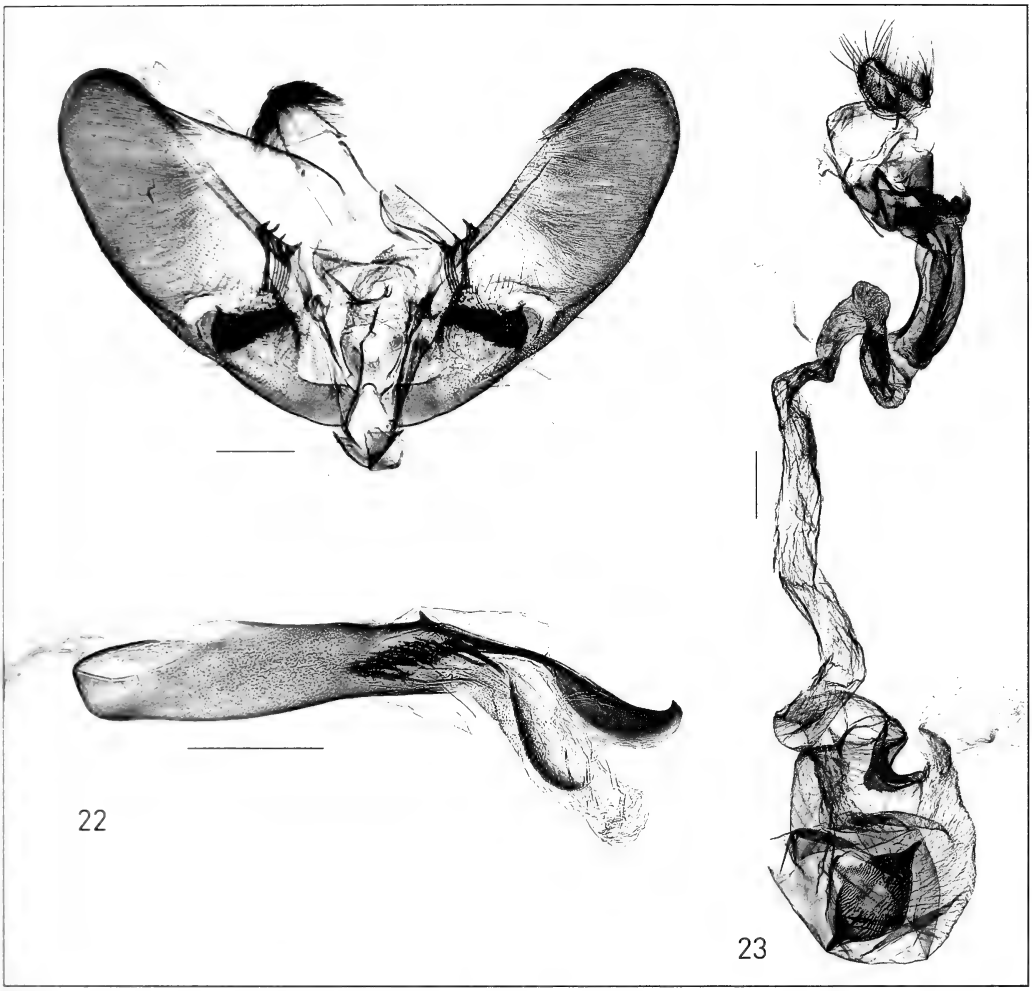
Figs 18–21. Female copulatory organs of *Anania* species; arrows pointing to digitiform structure (scale bars 500 µm). **18.** *A. funebris*, Austria, Klausen, Tirol, 6.vi.1921, prep. gen. AT60 (MTD). **19.** *A. delicatalis*, China, Moupin, viii.1890, prep. gen. 17373 (BMNH). **20.** *A. teneralis*, China, Sichuan Province, Batang, Zhubalong, 2500 m, 10.vii.2001, Houhun Li & Xinpu Wang leg., prep. gen. AT08009 (NKUM). **21.** *A. vicinalis*, Korea, Utikongo, Kongosan, 500 m, 25.vii.1940. H. Höne leg., prep. gen. AT63 (ZFMK).

of these genera with *Anania*, based on the common presence of the same characters mentioned by Maes.

In contrast to Leraut (2005), *Crypsiptya* is regarded here as distinct from *Anania* because of the different characters of the copulatory organs. The tubular structure inside the colliculum of *Crypsiptya* can be confused with the digitiform structure in the antrum of *Anania*, but they are not ragarded here as homologous as they are in different positions. Furthermore, it is questionable whether the phallic extension of *Crypsiptya* is homologous to the elongated sclerite of the phallus in *Anania* because the phallic extension of *Crypsiptya* is neither serrated nor distinctly sclerotized as in *Anania*.

The genitalia synapomorphies of *Anania* are found to be present in the three Chinese genera synonymized here. Despite the very strong swollen antrum of the species formerly treated in *Pronomis*, the digitiform structure and the asymmetric phallus apodeme can be clearly identified. Maes (2005) already mentioned that *Pronomis* shares the *Anania* characters we are now regarding as synapomorphies, but did not translate this into nomenclatural acts.

These characters are also present in the species of *Ethiobotys*, which was basically characterized by the dilated male antennae and dilated male mid tibia (Maes 1997).



Figs 22–23. Copulatory organs of *Crypsiptya coclesalis* (scale bars 500 µm). **22.** ♂ Hainan province, Wanning, Jianfeng Ling, Beidazheng Primary school, 110 m, 28.vii.2008, Bingbing Hu & Li Zhang, leg., prep. gen. AT58 (NKUM). **23.** ♀, China, Henan Province, Tongbai, Shuiliandong, 300 m, 26.vii.2000, Haili Yu leg., prep. gen. AT08011 (NKUM).

However, the dilated antennae are not synapomorphic for *Ethiobotys* because only *E. ankolae* shows this trait. The dilated mid tibia is not restricted to the afrotropical species placed in *Ethiobotys* as it is also present in males of the Chinese *Pronomis* (Munroe & Mutuura 1968). Thus, *Ethiobotys* clearly belongs to the ingroup of *Anania*.

Special traits are present in the genitalia of *Pronomis*, such as an asymmetrical signum of the corpus bursae (Fig. 19) and a strongly extended dent of the sella. However, the asymmetrical signum is also present in species formerly placed in *Tenerobotys* (Fig. 20, Munroe & Mutuura 1971). As these two taxa clearly present characters which allow to hypothesise their relationship within *Anania*, we prefer to lump them in order to obtain a monophyletic genus.

Though the nomenclatural changes introduced by Leraut (2005), which are largely supported in this paper, may upset the non-specialist, we argue in favour of the necessity to implement them in order to move to a natural generic classification of Pyraustinae. Also, it is our opinion that a large genus *Anania*, currently comprising 110 species, will provide more stability in the long term as the phylogenetic relationships between species still needs to be investigated. In our view, this procedure can help to revise the diversity of a species-rich group like Pyraustinae, containing approximately 1,400 species, currently still classified into 239 genera (Nuss et al. 2009). Regarding the fact that there are pyraustine genera containing several species like *Achyra* Guenée, 1849, *Hahncappsia* Munroe, 1976, *Loxostege* Hübner, 1825 and *Ostrinia* Hübner, 1825, or the very species-rich genus *Pyrausta* Schrank, 1802, the majority of the genera contain less than four species only. Because of the high number of species and genera within Pyraustinae, the analysis of their phylogeny will take a long time still. We regard the hypothesis of the monophyly of *Anania* just as one step towards the reconstruction of the natural relationships of pyraustine lineages that we have undertaken and that will be submitted to phylogenetic analysis.

In the future, the generic combination of the species provisionally assigned to *Anania* should be checked. A fascinating task remains in the study of the functional morphology of the copulatory organs of *Anania* species and their possible importance for speciation.

Acknowledgements

We thank Li Weichun (Nankai University, Tianjin, China) for his support during AT and M. Nuss' visit to Tianjin and for the translation of Chinese label data. We are also grateful to Reinhard Gaedike, Dieter Stüning (ZFMK, Bonn, Germany), Kevin Tuck (BMNH, London, Great Britain), and Peter Huemer (TLMF, Innsbruck, Austria) for providing specimens for investigation. The work was funded by the German Academic Exchange Service (DAAD) and the China Sholarship Council. We thank Bernard Landry (Genève, Switzerland) for critically reading our manuscript.

References

Amsel, H. G. 1956. Microlepidoptera Venezolana I. – Boletin de Entomologia Venezolana, Maracay **10** (1954) (1–2): 1–336.

Caradja, A. v. 1916. Beitrag zur Kenntnis der geographischen Verbreitung der Pyraliden und Tortriciden des europäischen Faunengebietes, nebst Beschreibung neuer Formen. – Deutsche entomologische Zeitschrift Iris, Dresden **30** (1): 1–88, errata p. 151–152.

Caradja, A. v. 1939. Materialien zu einer Mikrolepidopterenfauna des Yangtsetales bei Batang. – Deutsche entomologische Zeitschrift Iris, Dresden **53**: 15–26.

Christoph, H. T. 1881. Neue Lepidopteren des Amurgebietes. – Bulletin de la Société Impériale des Naturalistes de Moscou **56**: 1–80.

Denis, J. N. C. M. & I. Schiffermüller 1775. Ankündung eines systematischen Werkes von den Schmetterlingen der Wienergegend herausgegeben von einigen Lehrern am k.k. Theresianum. – Augustin Bernardi, Wien. frontispiece, 1–323, pls 1–3.

Doubleday, H. 1849. A synonymic list of British Lepidoptera. – London. 27 pp.

Germar, E. F. 1821. Augusti Ahrensii Fauna Insectorum Europae, Fasc. 4, Halle, Kümmel. – 25 pp., 25 pls.

Goater, B. 1986. British Pyralid Moths. A Guide to their Identification. – Harley Books, Colchester. frontispiece, 1–175, pls 1–8.

Guenée, M. A. 1854. Deltoides et Pyralites. Pp. 1–448. – *In*: J. B. A. D. de Boisduval & M. A. Guenée, Histoire Naturelle des Insectes. Species Général des Lépidoptères **8**. – Roret, Paris.

Hampson, G. F. 1912: Descriptions of new species of Pyralidae of the subfamily Pyraustinae. – Annals and Magazine of Natural History, including Zoology, Botany and Geology, London **(ser. 8) 9**: 149–174, 242–269, 321–336, 433–444, 625–633.

Hampson, G. F. 1918: Descriptions of new Pyralidae of the subfamily Pyraustinae. – Annals and Magazine of Natural History, including Zoology, Botany and Geology, London **(ser. 9) 1**: 125–136, 252–262, 265–280.

Hübner, J. 1796–1833 [imprint „1796"] (a). Sammlung europäischer Schmetterlinge. 6. Horde. Die Zünsler; nach der Natur geordnet, beschrieben und vorgestellt (continued by C. Geyer). – Augsburg. [i]–[iv], [i–ii], [i–ii], 1–30, [i–ii], [i–ii], pls. 1–32.

Hübner, J. 1796–1836 [imprint „1796"] (b). Sammlung europäischer Schmetterlinge. 8. Horde. Die Schaben; nach der Natur geordnet, beschrieben und vorgestellt (continued by C. Geyer). – Augsburg. [1]–[12]–13–70–[71]–[78], pls. 1–71.

Hübner, J. 1816–1826 [imprint "1816"] (c). Verzeichniß bekannter Schmettlinge [sic]. – bey dem Verfasser zu finden, Augsburg. (Verzeichniß) [1]–[3]–4–6–[7]–8–431, (Anzeiger) [1]–2–72.

Hübner, J. 1819–1823 [imprint "1823"] (d). Zuträge zur Sammlung exotischer Schmettlinge [sic], bestehend in Bekundigung einzelner Fliegmuster neuer oder rarer nichteuropäischer Gattungen. – Augsburg. [1]–[3]–4–6–[7]–8–3–33]–[40], pl. [36]–[69].

Hufnagel, J. S. 1767. Fortsetzung der Tabelle von den Nachtvögeln, welche die 3te Art derselben, nehmlich die Spannenmesser (Phalaenas Geometras Linnaei) enthält. – Berlinisches Magazin, Berlin **4** (5, 6): 504–527; 599–626.

Inoue, H. 1960. Two new species of the Pyralididae from Japan (Lepidoptera). – Kontyû. Entomological Society of Japan, Tokyo **28** (3): 170–171, pl. 10.

Inoue, H. 1988. A new species of Epipaschiinae from Japan, with some synonymic notes on the Pyralidae from east Asia (Lepidoptera). – Tinea, Tokyo **12** (10): 85–95.

Karsholt, O. & J. Razowski 1996. The Lepidoptera of Europe. A distributional checklist. – Apollo Books, Stenstrup, Denmark. 1–380, 1 CD-ROM.

Kenrick, G. H. 1917: New or little-known Heterocera from Madagascar. – Transactions of the Entomological Society of London **1917**: i–xli, 1–426.

Kirpichnikova, V. A. 1996. Species of the genus *Opsibotys* Warren of Russia (Lepidoptera: Pyralidae). – Zoosystematika Rossica, St. Petersburg **4** (2): 311–312.

Kristensen, N. P. 2003: Skeleton and muscles: adults. pp. 39–131. – *In*: N. P. Kristensen, Lepidoptera, moths and butterflies. Vol. 2: Morphology, physiology, and development. – *In*: M. Fischer, Handbook of Zoology IV (36). – Walter de Gruyter, Berlin and New York.

Lederer, J. 1863. Beitrag zur Kenntniss der Pyralidinen. – Wiener Entomologische Monatschrift **7** (8, 10– 12): 243–280, 331–504, pls 2–18.

Leech, J. H. 1901. Lepidoptera Heterocera from China, Japan, and Corea. With descriptions of new species by Richard South, F.E.S.. – Transactions of the Entomological Society of London: 385–514, pls 14–15.

Leraut, P. J. A. 2005. Contribution à l'étude de quelques genres et espèces de Pyraustinae (Lepidoptera: Crambidae). – Nouvelle Revue d'Entomologie, Paris **22** (2): 123–139.

Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. – Laurentii Salvii, Holmiae. 1–824.

Maes, K. V. N. 1994. Some notes on the taxonomic status of the Pyraustinae (sensu Minet 1981 [1982]) and a check list of the Palaearctic Pyraustinae (Lepidoptera, Pyraloidea, Crambidae). – Bulletin et Annales de la Société Royale Entomologique de Belgique, Bruxelles **130** (7–9): 159–168.

Maes, K. V. N. 1997. *Ethiobotys*, a new genus of Pyraustinae from the Afrotropical region (Lepidoptera: Pyraloidea: Crambidae. – Bulletin et Annales de la Société Royale Entomologique de Belgique, Bruxelles **133** (3): 389–402.

Maes, K. V. N. 2002. The genus *Crypsiptya* in Africa with the description of a new species and a world checklist of the genus (Lepidoptera Pyraloidea Crambidae Pyraustinae). – Belgian Journal of Entomology, Bruxelles **4** (1): 27–32.

Maes, K. V. N. 2003. A world checklist of the genus *Anania* Hübner, 1823 with the description of a new species from Africa (Lepidoptera, Pyraloida, Crambidae, Pyraustiane). – Bulletin de la Société Royale Belge d'Entomologie **139** (1–6): 94–96.

Maes, K. V. N. 2005. Revisionary notes on the genus *Algedonia* with emphasis on the Afrotropical region (Lepidoptera, Pyraloidea, Crambidae, Pyraustinae). – Journal of Afrotropical Zoology, Tervuren **75**: 75–103.

Marion, H. 1954. Révision des Pyraustidae de la faune française (suite). – Revue française de Lépidoptérologie, Paris **14**: 181–188, 221–227.

Marion, H. 1959. Classification et nomenclature des Pyraustinae d'Europe. – L'Entomologiste, Paris **15** (3): 44–45.

Meyrick, E. 1894. On Pyralidina from the Malay Archipelago. – Transactions of the Entomological Society of London: 455–480.

Minet, J. 1982: Les Pyraloidea et leurs principales divisions systématiques (Lep. Ditrysia). – Bulletin de la Société entomologique de France, Paris **86** (1981): 262–280.

Munroe, E. G. 1976. Pyraloidea Pyralidae comprising the subfamily Pyraustinae tribe Pyraustini (part). Pp. 1–78, pls 1–4, A–H. – *In*: R. B. Dominick et al., The Moths of America north of Mexico 13.2A 13.2A. – E.W. Classey Ltd. and The Wedhe Entomological Research Foundation, London.

Munroe, E. G. 1995: Pyraustinae. pp. 53–79. – *In*: J. B. Heppner, Atlas of Neotropical Lepidoptera. Checklist: Part 2. Hyblaeoidea - Pyraloidea - Tortricoidea 3. – Association for Tropical Lepidoptera & Scietific Publishers, Gainesville.

Munroe, E. G. & A. Mutuura 1968. Contributions to a study of the Pyraustinae (Lepidoptera: Pyralidae) of temperate East Asia IV. – The Canadian Entomologist, Ottawa **100** (9): 986–1001

Munroe, E. G. & A. Mutuura 1969 a. Contributions to a study of the Pyraustinae (Lepidoptera: Pyralidae) of temperate East Asia VI. – Canadian Entomologist, Ottawa **101** (9): 897–906.

Munroe, E. G. & A. Mutuura 1969 b. Contributions to a study of the Pyraustinae (Lepidoptera: Pyralidae) of temperate East Asia VIII. – The Canadian Entomologist, Ottawa **101** (12): 1239–1248.

Munroe, E. G. & A. Mutuura 1971. Contributions to a study of the Pyraustinae (Lepidoptera: Pyralidae) of Temperate East Asia XI. – Canadian Entomologist, Ottawa **103**: (2) 173–181.

Mutuura, A. 1954. Classification of the Japanese *Pyrausta* group based on the structure of the male and female genitalia (Pyr.: Lep.). – Bulletin of the Naniwa University, Ser. B, Sakai **4**: 7–33.

Nuss, M. et al. 2009. Global Information System on Pyraloidea (GlobIZ). – URL: www.pyraloidea.org

Nuss, M. & W. Speidel 2005: Introduction. pp. 7–20. – *In*: B. Goater, M. Nuss & W. Speidel, Pyraloidea I. – *In*: P. Huemer & O. Karsholt, Microlepidoptera of Europe 4. – Apollo Books, Stenstrup.

Palm, E. 1986. Nordeuropas Pyralider – med saerligt henblik paa den danske fauna (Lepidoptera: Pyralidae). Pp. 1–287, pls 1–8. – *In*: L. Lyneborg, Danmarks Dyreliv. Fauna Bøger 3 3. – National-Trykkerit, Copenhagen.

Pierce, F. N. & J. W. Metcalfe 1938. The genitalia of the British Pyrales with the Deltoids and Plumes. – Oundle, Northants. frontispiece, i–xiv, 1–67, pl. i–xxix.

Robinson, G. S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. – Entomologist's Gazette, London **27**: 127–132.

Shaffer, M., E. S. Nielsen & M. Horak 1996. Pyraloidea. Pp. 164–199. – *In*: E. S. Nielsen, E. D. Edwards & T. V. Rangsi, Checklist of the Lepidoptera of Australia. – *In*: E. S. Nielsen, Monographs on Australian Lepidoptera **4**. – CSIRO Division of Entomology, Canberra.

Solis, M. A. & K. V. N. Maes 2003. Preliminary phylogenetic analysis of the subfamilies of Crambidae (Pyraloidea Lepidoptera). – Belgian Journal of Entomology, Bruxelles **4** (2002) (2): 53–95.

Speidel, W. & H. Hanigk 1990. Revision der paläarktischen Arten der Gattung *Algedonia* (Lepidoptera, Crambidae). – Bonner zoologische Beiträge **41** (3–4): 259–275.

Ström, H. 1768. Beskrivelse over Norske Insecter. – Kongelige Norske Videnskabers Selskabs Skrifter, Copenhagen & Trondheim **4**: 313–371, 590 pl. 16.

Treitschke, F. 1828. Die Schmetterlinge von Europa (Fortsetzung des Ochsenheimer'schen Werks) **6** (2). – Gerhard Fleischer, Leipzig. Pp. 1–319.

Treitschke, F. 1829. Die Schmetterlinge von Europa (Fortsetzung des Ochsenheimer'schen Werkes) **7**. – Gerhard Fleischer, Leipzig. Pp. i–vi, 1–252.

Turati, E. 1913. New species and new forms of Lepidoptera from Sardinia. – Entomologist's Record and Journal of Variation, London **25** (1): 16–18.

Walker, F. 1859. Pyralides. – List of the Specimens of Lepidopterous Insects in the Collection of the British Museum, London **18**: 509–798.

Warren, W. 1890. Descriptions of some new genera of Pyralidae. – Annals and Magazine of Natural History, including Zoology, Botany and Geology, London **(ser. 6) 6**: 474–479.

Warren, W. 1892. Descriptions of new genera and species of Pyralidae contained in the British Museum collection. – Annals and Magazine of Natural History, including Zoology, Botany and Geology, London **(ser. 6) 9**: 172–179, 294–302, 389–397, 429–442.

Warren, W. 1896. New genera and species of Pyralidae, Thyrididae, and Epiplemidae. – Annals and Magazine of Natural History, including Zoology, Botany and Geology, London **(ser.6) 17**: 94–106, 131–150, 202–216.

Yamanaka, H. 1966. A revisional study of the Japanese *Anania*, with description of a new species. – Bulletin of the Naniwa University, Ser. B, Sakai **15** (6): 31–40.

Yamanaka, H. 1987. Two new species of the Pyraustinae (Lepidoptera: Pyralidae) from Japan. – Tinea, Tokyo **suppl. 12**: 192–196.

Yamanaka, H. 2000. Pyralidae of Nepal (III). – Tinea, Tokyo **16, suppl. 1** (Moths of Nepal 6): 63–69, pl. 163.

Zeller, P. C. 1847. Bemerkungen über die auf einer Reise nach Italien und Sicilien beobachteten Schmetterlingsarten. – Isis von Oken, Leipzig (2–4, 6–12): 121–159, 213–233, 284–308, 401–457, 483–522, 561–594, 639–67.

First record of *Cacyreus marshalli* (Lycaenidae) from the Balkan Peninsula

Kosmač Marko[1] & Rudi Verovnik[2]

[1] Župančičeva 8a, 5270 Ajdovščina, Slovenia; e-mail: kosmacmarko@volja.net
[2] University of Ljubljana, Biotechnical Faculty, Department of Biology, Večna pot 111, 1000 Ljubljana, Slovenia; e-mail: rudi.verovnik@bf.uni-lj.si

Cacyreus marshalli Butler, 1898, a native of South Africa, was accidentally introduced in the Balearic archipelago in about 1990 by imported, ornamental *Pelargonium* (Geraniaceae), one of its larval food plants (Eitschberger & Stamer 1990; Raynor 1990; Sarto i Monteys 1992). Since then it has become one of the best studied invasive butterfly species in Europe and its range expansion has been well documented. Records from mainland Spain (Sarto i Monteys 1992) and surprisingly Belgium (Troukens 1991) were soon to follow. Unlike in Belgium, the discoveries in mainland Spain refer to established breeding populations that mark the beginning of its large scale range expansion in Europe. The expansion continued in neighbouring France, Portugal and Morocco (Tarrier 1998), and quickly followed in Italy, where the butterfly was first recorded from Rome (Trematerra et al. 1997). Since then, there have been records from most of Italy, including Sardinia (Quacchia et al. 2008). Despite its recent publication the distribution map in Quacchia et al. (2008) is already outdated as the species has been observed further eastwards as far as Vicenza (Stefano Beretta, pers. comm.). The butterfly was recently found also on Malta Island (Sammut 2007), which represents its easternmost record in Europe. Given the fast colonization speed of *C. marshalli* it is surprising that the species has not so far been observed along the western coast of the Balkan Peninsula together with its offshore islands.

During summer holidays the first author visited Lošinj Island, a well-known tourist destination in Croatia. On August 8, 2008 he observed a small dark lycaenid flying along the coast and settling on low bushes of *Inula crithmoides* L. (Asteraceae). The butterfly was not shy and upon close inspection was immediately recognised as *C. marshalli*. It was observed on the west coast of a small peninsula at about 2 km NW of the town of Mali Lošinj (44° 32‘ 10“ N, 14° 26‘ 42“ E) (Fig. 1). There were no *Pelargonium* plants nearby, but they are abundantly grown in Mali Lošinj. Despite an intensive search no further specimens were found in the following days. Therefore, it is still too early to state that this single record represents a successful colonization and that there is a breeding population on the island. However, the mild climate in the region is favourable for the reproductive success of the species and hence its permanent colonization, both being factors that may eventually trigger further spread of *C. marshalli* in the Balkan Peninsula in the forthcoming years.

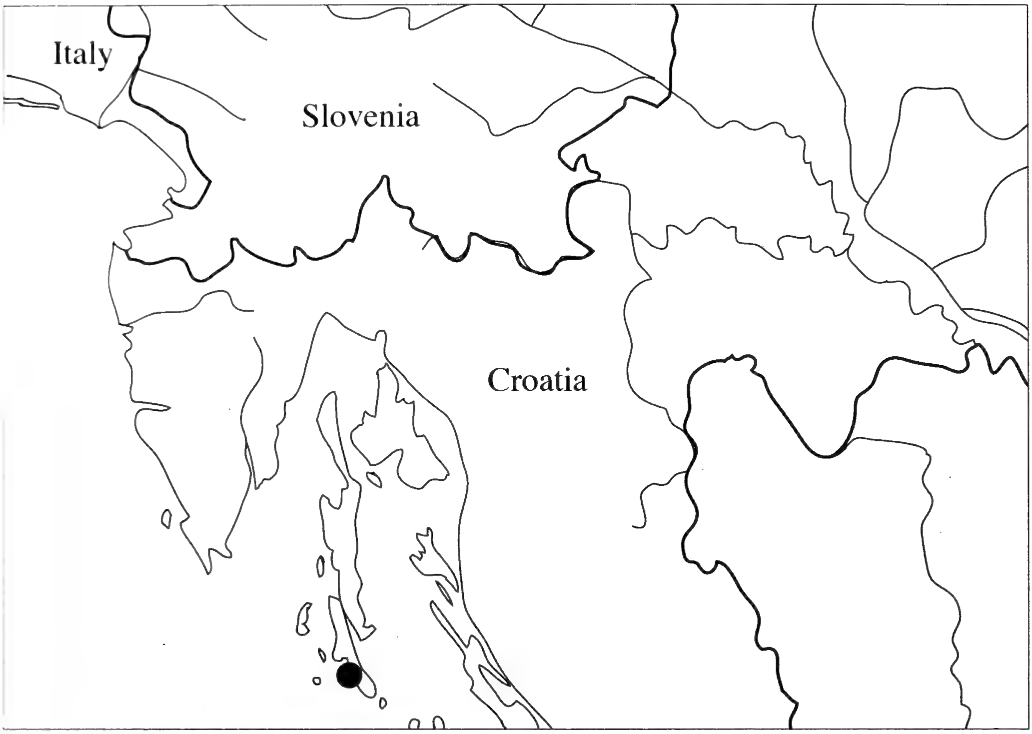


Fig. 1. Approximate position of the observation site of *Cacyreus marshalli* in Croatia.

References

Eitschberger, U. & P. Stamer 1990. *Cacyreus marshalli* Butler, 1898, eine neue Tagfalterart für die europäische Fauna? (Lepidoptera, Lycaenidae). – Atalanta **21** (1/2): 101–108.

Quacchia, A., C. Ferracini, S. Bonelli, E. Balletto & A. Alma 2008. Can the Geranium Bronze, *Cacyreus marshalli*, become a threat for European biodiversity? – Biodiversity and Conservation **17**: 1429–1437.

Raynor, E. M. 1990. The occurrence of a *Cacyreus* species (Lep.: Lycaenidae) in Majorca. – Entomologist's Record **102**: 250.

Sammut, P. 2007. *Cacyreus marshalli* Butler, [1898] reaches the Maltese Islands (Lepidoptera: Lycaenidae). – SHILAP Revista de lepidopterología **35** (139): 317–319.

Sarto i Monteys, V. 1992. Spread of Southern African Lycaenid butterfly, *Cacyreus marshalli* Butler, 1898, (Lep: Lycaenidae) in the Balearic Archipelago (Spain) and considerations on its likely introduction to continental Europe. – Journal of Research on the Lepidoptera **31**: 24–34

Tarrier, V. 1998. *Cacyreus marshalli* Butler, 1898 espèce nouvelle pour la France, le Portugal et le Maroc. – Alexanor **20** (3): 143–144.

Trematerra, P., A. Zilli, V. Valentini & P. Mazzei 1997. *Cacyreus marshalli*, un lepidottero sudafricano dannoso ai gerani in Italia. – Informatore Fitopatologico **7–8**: 2–6.

Troukens, W. 1991. *Cacyreus marshalli* Butler, 1898 aangetroffen in Belge (Lepidoptera: Lycaenidae). – Phegea **19** (4): 129–131.

Gilligan, T.M., D.J. Wright and L.D. Gibson 2008. Olethreutine Moths of the Midwestern United States. An Identification Guide. – Ohio Biological Survey Bulletin New Series, **16**(2): vii + 334 pp. ISBN 978-0-86727-160-7. 75.00 USD. Hardcover, 220 × 285 mm format.

The microlepidoptera fauna of North America is not so well known as the European and new species are described on a regular basis. Perhaps due to this unstable taxonomic knowledge the production of identification guides is not so frequent at the other side of the Atlantics. Three well known experts on the Tortricidae fauna of the United States have challenged this scenario with the publication of a finely edited book on the Olethreutine Moths of the Midwestern United States. The Midwestern United States, generally referred to simply as the Midwest or The Heartland, is one of the four main geographic regions within the United States of America. It extends over twelve states. Really the coverage of this long term research is biased toward the central and eastern portions of this region, including Kentucky, really a Southern state. The Olethreutinae is one of the major three subfamilies of the Tortricidae. It includes 306 species in the area covered by this survey, what represents approximately one-third of the Nearctic fauna. The book is organized in three parts. The first part is a general introduction to the subfamily, including a wonderfully illustrated morphological overview that clearly states the characters that are going to be used in the rest of the text. The main second part, called 'Species Accounts', is systematically arranged. Each genus is introduced with comments on species richness, general distribution, larval habits and characteristic features of genitalia and wing pattern. Every species is then treated with sections devoted to forewing length, flight period, distribution, biology and remarks, where comments on diagnostic discrimination and variation are given. A full colour image of the adult, scaled to a standard size of about half page width, is included. When necessary, underside photographs have also been added. For those interested in relative size, five full colour plates have also been included where all the adults are represented at same scale. Male and female genitalia are separately illustrated through more than 650 black and white photographs grouped in 106 plates. The 19 pages third part is a collaboration authored by Steven Passoa and devoted to immature stages. Eggs, larvae and pupae of the most common species, frequently of economic importance, are treated and full colour illustrated, with a key of identification of larvae based on Mackay's classical treatment of the North American olethreutines. Literature, general indexes as well as hot plant index complete the publication. The book is dedicated to William E. Miller, one of the most influential tortricid experts of North America.

This is a carefully edited and beautifully illustrated book, a reference for those intending similar projects in other parts of the world. It is obviously essential for those interested in the Nearctic microlepidoptera and in general on the tortricoid fauna. But in spite of its geographic coverage, the European microlepidopterists will find this book also useful. Those unfamiliar with the systematic treatment generally accepted by our American colleagues will be curious about some arrangements especially around the genera *Eucosma* and *Olethreutes* what certainly compel us to remain open minded on a more Holarctic view. It is clearly presented, with lots of useful general information and definitely an attractive publication at a reasonable price.

The book may be obtained through the Ohio Biological Survey, P.O. Box 21370, Columbus, Ohio 43221-0370, email:ohiobiosurvey@rrohio.com, http://www.ohiobiologicalsurvey.org.

Joaquín Baixeras Almela

Alexander Schintlmeister 2008. Notodontidae. Palaearctic Macrolepidoptera. Volume 1. – Apollo Books, Stenstrup. 482 pp. (incl. 40 colour-plates). ISBN 978-87-88757-77-4. Price: € 140.00. (See www.apollobooks.com)

Alexander Schintlmeister has been working on the taxonomy of the Notodontidae of the Palaearctic and Oriental Regions for more than 25 years. He is running a private business and therefore might be called an amateur entomologist, but in 1987, he defended his *dissertatio* at Humboldt University in Berlin on the systematics and biogeography of West-Palaearctic notodontids. Since that time, he extensively collected notodontids in many countries like Russia, China, Vietnam, Indonesia, and the Philippines and also accumulated material from other collectors. Based on this comprehensive collection, he fundamentally contributed to our knowledge on the Notodontidae from the Old World by numerous publications.

Alexander Schintlmeister's most recent publication on the Notodontidae of the Palaearctic Region is a synthesis of the available knowledge so far only available in scattered publications. But it is also an original publication including numerous nomenclatural acts such as the descriptions of 38 new species, 21 new subspecies, as well as 16 new generic combinations, 44 new synonyms, and 17 status changes.

The book starts with an introduction on some historical aspects of the history on taxonomic research on Notodontidae and explains the main morphological features used in the book. The classification of the group is shortly explained, followed by a checklist of Palaearctic Notodontidae, comprising 716 species. A short chapter on biogeography is reminiscent of Gustaf de Lattin's work (1967) in using terms like 'faunal elements', 'centre of origin,' and 'centre of expansion,' that, however, often represent a guess rather than a precise scientific reasoning. The systematic part, comprising nearly 400 pages, is a concise treatment of the 716 species. For every species, the text provides information on type locality, diagnosis, life history, and distribution. Male and female genitalia illustrations are provided as black & white photographs and the distribution is represented on a map. The concise treatments focus on the identification of the species and refrain from extensive descriptions, which would have made the book uneconomical. The distribution maps can be regarded as very comprehensive as they are based on the author's large collection. The book concludes with biographical notes on entomologists who contributed to 'Notodontology', a synopsis of taxonomic changes, a list of references, 40 colour plates, and an index to scientific names of Notodontidae. The colour plates illustrate spread moths in excellent quality. They are the eye-catcher of the volume and certainly contribute much to an easy identification of the species, which is supported by arrows pointing to differences of closely related species.

I regard this volume as a successful work, outstandingly suitable and efficient to use for the identification of Palaearctic Notodontidae. I fully recommend it to anybody interested in Palaearctic Lepidopterology, biogeography of Lepidoptera, or just notodontids. The book might be also taken as an example on how to prepare such a comprehensive topic economically.

Matthias Nuss

References

de Lattin, G. 1967. Grundriss der Zoogeographie. – Gustav Fischer, Jena. 602 pp.

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA e.V.

Nota lepidopterologica wird als wissenschaftliche Zeitschrift von der Societas Europaea Lepidopterologica (SEL) herausgegeben und den Mitgliedern der SEL zugesandt. Autoren, die Manuskripte für die Publikation in der *Nota lepidopterologica* einreichen möchten, finden die jeweils gültigen Autorenrichtlinien auf der Homepage der SEL unter http://www.soceurlep.eu. Der Verkauf von Einzelheften und älteren Jahrgängen von *Nota lepidopterologica* sowie der Verkauf der Zeitschrift an Nichtmitglieder erfolgt durch Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup; e-mail: apollobooks@vip.cybercity.dk. Die Mitgliedschaft bei der SEL steht Einzelpersonen und Vereinen nach Maßgabe der Satzung offen. Der Aufnahmeantrag ist an den Mitgliedssekretär Willy De Prins, Dorpstraat 401 B, B-3061 Leefdaal, Belgien; e-mail: willy.de.prins@telenet.be zu richten. Das Antragsformular ist im Internet auf der Homepage der SEL erhältlich. Der Mitgliedsbeitrag ist jährlich am Jahresanfang zu entrichten. Er beträgt für Einzelpersonen € 35,00 bzw. für Vereine € 45,00. Die Aufnahmegebühr beträgt € 2,50. Die Zahlung wird auf das SEL-Konto 19 56 50 507 bei der Postbank Köln (BLZ 370 100 50) erbeten (IBAN: DE63 3701 0050 0195 6505 07; BIC: PBNKDEFF). Mitteilungen in Beitragsangelegenheiten werden an den Schatzmeister Dr. Robert Trusch, Staatliches Museum für Naturkunde, Erbprinzenstr. 13, 76133 Karlsruhe, Germany; e-mail: trusch@smnk.de erbeten. Adressenänderungen sollten umgehend dem Mitgliedssekretär oder dem Schatzmeister mitgeteilt werden.

Published by the Societas Europaea Lepidopterologica (SEL), *Nota lepidopterologica* is a scientific journal that members of SEL receive as part of their membership. Authors who would like to submit papers for publication in *Nota lepidopterologica* are asked to take into consideration the relevant instructions for authors available on the SEL homepage at http://www.soceurlep.eu. The sales of single and back issues of *Nota lepidopterologica* as well as sales to non-members of SEL are under the responsibility of Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup; e-mail: apollobooks@vip.cybercity.dk. The membership is open to individuals and associations as provided for by the statutes of SEL. Applications for membership are to be addressed to the Membership Secretary Willy De Prins, Dorpstraat 401 B, B-3061 Leefdaal, Belgium; e-mail: willy.de.prins@telenet.be. The application form is available on the SEL homepage. The annual subscription is to be paid at the beginning of the year. It is 35.00 € for individuals or 45.00 € for associations. The admission fee is 2.50 €. Dues should be paid to SEL account no. 19 56 50 507 at Postbank Köln [Cologne] (bank code 370 100 50; IBAN: DE63 3701 0050 0195 6505 07; BIC: PBNKDEFF) or to local treasures as mentioned on the website. Communications related to membership contributions should be sent to the Treasurer Dr Robert Trusch, Staatliches Museum für Naturkunde, Erbprinzenstr. 13, 76133 Karlsruhe, Germany; e-mail: trusch@smnk.de. Changes of addresses should be immediately communicated to the Membership Secretary or the Treasurer.

Publié par la Societas Europaea Lepidopterologica (SEL), *Nota lepidopterologica* est un périodique scientifique envoyé à tous les membres de la SEL. Les auteurs qui désirent publier des manuscrits dans la revue sont priés de tenir compte des Instructions aux auteurs disponibles sur le site Web de la SEL: http://www.soceurlep.eu. Les ventes de numéros supplémentaires ou d'anciens numéros de *Nota lepidopterologica*, ainsi que les ventes de numéros aux personnes n'étant pas membres de la SEL sont sous la responsabilité de Apollo Books, Kirkeby Sand 19, DK-5771 Stenstrup; courriel: apollobooks@vip.cybercity.dk. Tel que prévu dans ses statuts, les individus de même que les associations peuvent devenir membres de la SEL. Les demandes d'adhésion doivent être envoyées au Secrétaire responsable des adhésions, Willy De Prins, Dorpstraat 401 B, B-3061 Leefdaal, Belgique; courriel: willy.de.prins@telenet.be. Le formulaire d'adhésion est disponible sur le site Web de la SEL. L'adhésion se paie au début de l'année. Elle est de 35 € pour les individus et de 45 € pour les associations. Les frais d'admission sont de 2,50 €. Les paiements peuvent être envoyés au compte de la SEL: no. 19 56 50 507, Postbank Köln [Cologne] (code bancaire 370 100 50; IBAN: DE63 3701 0050 0195 6505 07; BIC: PBNKDEFF) ou au trésorier local tel que mentionné sur le site Web.. Toute question en rapport avec l'adhésion doit être envoyée au Trésorier, Dr. Robert Trusch, Staatliches Museum für Naturkunde, Erbprinzenstr. 13, 76133 Karlsruhe, Germany; courriel: trusch@smnk.de. Tout changement d'adresse doit être mentionné immédiatement au Secrétaire responsable des adhésions ou au Trésorier.